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FOR

ROYAL ARMY MEDICAL CORPS TERRITORIAL FORCE CADETS

(PROVISIONAL).

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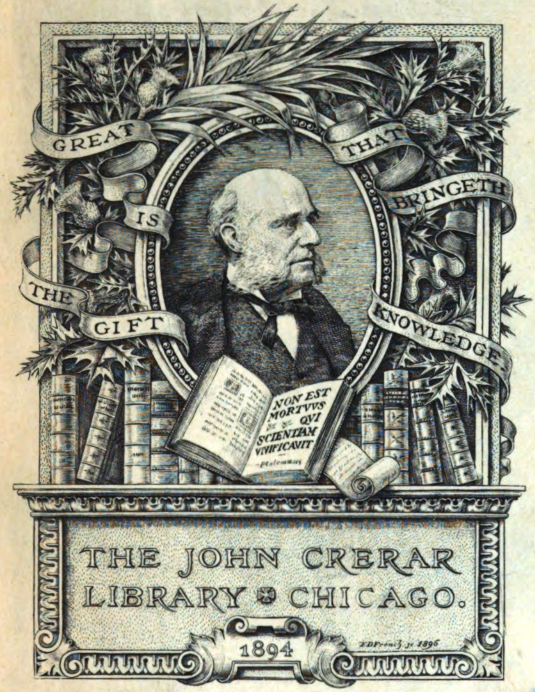
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TRAINING MANUAL

FOR

ROYAL ARMY MEDICAL CORPS TERRITORIAL FORCE CADETS

(**PROVISIONAL**).

1920.

WAR OFFICE.

LONDON:
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This Manual is issued by command of the Army Council for the guidance of all concerned.

H. J. CREEDY,
Secretary, Army Council.

WAR OFFICE,
August, 1920.

ABBREVIATIONS.

A.M.O.	Administrative Medical Officer.
C.O.	Commanding Officer.
D.D.M.S.	Deputy Director of Medical Services.
D.M.S.	Director of Medical Services.
G.O.C.	General Officer Commanding.
G.O.C.-in-C.	General Officer Commanding-in-Chief.
G.S.	General Staff.
I.G.C.	Inspector-General of Communications.
L. of C.	Line of Communications.
M.O.	Medical Officer.
N.C.O.	Non-Commissioned Officer.
O.C.	Officer Commanding.
P.M.O.	Principal Medical Officer.
Q.M.G.	Quartermaster-General.
R.A.M.C.	Royal Army Medical Corps.

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INTRODUCTION.

A healthy body begets a healthy active mind, the one being the natural corollary of the other.

In the compilation of this manual, every endeavour has been made to place in the hands of the cadet a useful guide to both the theoretical and practical side of Royal Army Medical Corps work.

The cadet should, during the period which he devotes to training, acquire all the knowledge and information he can; he should work hard, and concentrate in an effort to master the first principles of military medical training and first aid—the measure of the success which he achieves will depend on his individual effort.

There is no Royal road to learning, and if he will but realize that a thorough knowledge of the contents of this manual will prove of great value to himself, not only in his military capacity, but also from the point of view of his usefulness as a member of the civil community, the subject will prove of great interest, and the mastering of it easy, but he must have the will to work and to learn.

He may at any time be called upon to put to practical tests the lessons he has learned; he may find himself in a position where the steps which he takes may result in his saving or losing a life—perhaps the life of his dearest friend.

If he should ever be placed in such a position away from the guiding hand of his instructor, who during the courses which he attended was always at hand to help and advise, he will be well repaid for all the time and energy expended in acquiring knowledge and experience if he can, with complete confidence that he is doing the right thing in the particular emergency which may arise, apply the lessons which he has been taught. Many a soldier in the Great War, which has so recently been successfully concluded, owed his life to the fact that he had beside him, when wounded, a comrade who could bind up his wound, arrest hæmorrhage, or prevent infection coming into contact with the wound, leading to complications resulting in the loss of a limb or even death.

There is nothing written in this volume which may not prove of immense value to the cadet who reads and masters its contents, remembering always that there is no greater virtue than the ability and the will to help others.

Cadets should be thoroughly instructed in Infantry (Squad, Section and Platoon) Drill, and in Physical Training (*see* "Manual of Cadet Infantry Training").

Drill with arms should in no case be given.

During his first year, the cadet should be instructed in Part I, viz., Sanitation and the Transport of Wounded.

During his second year, instruction in Parts II and III should be given, viz., Medical Corps Drills and Exercises and Training in First Aid.

E. WORTHINGTON, *Colonel*,
Assistant Director-General,
Army Medical Service.

THE WAR OFFICE,
April, 1920.

ROYAL ARMY MEDICAL CORPS TERRITORIAL FORCE CADETS.

PART I.

GENERAL INSTRUCTIONS.

1. **Ceremonial.**—The ceremonial drill for the R.A.M.C. is contained in "Ceremonial."

The official March of the Corps is "Her bright smile haunts me still." Published by Hawkes and Son, London.

2. **R.A.M.C. Call.**—The calls for the Royal Army Medical Corps are given in The Trumpet and Bugle Sounds for the Army.

The following is the Corps Call :—

FIG. 1.—R.A.M.C. CALL.

Sanitation or the Prevention of Disease.
The Transport of Wounded.

CHAPTER I.

THE CAUSES OF DISEASE.

3. The prevention of disease depends largely on a knowledge of its causes. If we look closely into the nature of the chief diseases we find that they can be divided, roughly, into the following groups : (1) diseases which are the result of some inherited defect or fault in the make of the body ; (2) diseases which are the result of accident or injury ; (3) diseases which are the effect or result of climate ; (4) diseases which are due to either foolish habits or faulty modes of life ; and (5) diseases which are due to some cause or causes introduced into the body from without.

So far as soldiers are concerned, we may say that the first group does not apply, as all soldiers are medically examined before they

enlist, and no men become soldiers who have bodily defects likely to give rise to sickness or disease. The second group we may dismiss as largely non-preventable; accidents and injuries are bound to occur occasionally, even in a well-regulated army. Of the diseases caused by climate or weather, it is doubtful whether there are many, the chief one occurring among soldiers being sunstroke or heatstroke. In the fourth group are such diseases as the various venereal affections, alcoholism, and those forms of sickness, the result of the abuse of both drink and food. In the last or fifth group are diseases like enteric fever, cholera, dysentery, smallpox, plague, malaria and a number of others, all of which are caused by the entering into the body from without of the cause, which is a living thing or germ.

It is quite clear that, from the nature of this causation, the various diseases included in the last three groups are more or less preventable. Thus, sunstroke and heatstroke can be avoided by the exercise of reasonable care in safeguarding the head from the effects of the direct rays of a powerful sun and otherwise protecting the body from the effects of excessive heat. In the same way, venereal diseases can be avoided by the exercise of chastity and self-control, while, too, the effects of excessive eating and drinking are to be controlled by self-discipline, moderation, and common-sense. The avoidance and prevention of the diseases in the remaining groups is not quite so simple, and involves a consideration of the nature and mode of action of the germs or the living things which are their cause.

4. Microbes or Germs.—The size and shape of the living things which are sometimes called germs or microbes, and which are the cause of a number of diseases, vary; their size may be anything from one five-thousandth to one ten-thousandth part of an inch, and their shape may be equally variable.

It must not be supposed that all bacteria or germs are hurtful and capable of producing disease; it is far otherwise. The majority of micro-organisms do good, and we could not carry on our lives without them; it is only a small number which are harmful to man and able to cause disease. Should, by chance, these disease-producing germs or bacteria gain access and a foothold, as it were, in man's body, they grow and increase in numbers. Sometimes they prefer to grow in the blood, at other times in the lungs, or spleen, or liver, or the bone marrow, while sometimes they prefer to grow inside the bowel, or perhaps outside the body on the skin or in the roots of the hair. The greater number of the disease-producing germs live and thrive in the blood and other juices of the body. While growing and multiplying there they make or excrete a poison or *toxin*, as it is called, and it is the circulation of this poison or toxin in the blood and body juices which makes a man ill and gives rise to the various symptoms of the particular disease which is being caused. Whether a person is going to recover or not from the effects of the growth of the disease germs in his body depends upon how well or how successfully he can manufacture an antidote

or corrective to the poison made and poured into his system by the germs. If sufficient of the antidote is made, then the germs are gradually killed and their poison neutralized, followed by the gradual recovery of the sick person. If, on the other hand, the germs make so much of the poison or the patient fails to make sufficient antidote to neutralize the germ poison, then he dies as the result of the disease caused.

This behaviour of these disease-producing germs in the human body is very similar to the action of yeast or other ferments when growing in sugar solutions, such as malt and water, or apple juice or grape juice. From these sugar solutions are made respectively beer, cider, wine, or brandy. Consider the case of wine for a moment. The vintner takes the ripe grapes and throws them into a vat or tub. By crushing them up he makes a sugary liquid into which pass various microbes, either from the air or by means of the skins of the grapes which are in the sugary mass. Certain of these germs or microbes from the air or attached to the grape-skins ferment the sugar, that is, split it up into carbonic acid gas and alcohol. This action of the ferment goes on until sufficient alcohol has been made so as to constitute 14 per cent. of the sugary juices. When this amount of alcohol has been formed, fermentation ceases, owing to the excess of alcohol. This is very much the same as occurs in the human body when certain of the disease-producing germs gain access to it; they go on growing and fermenting, as it were, in the blood and juices of the body until the body has manufactured a sufficiency of the antidote to stop their action. It is this curious resemblance between the two processes that has suggested the name of "fermentation-like" for many of these diseases, simply because their germs or causes behave in the human body like a ferment. Typical examples of diseases of this nature are smallpox, chicken-pox, measles, scarlet fever, enteric fever, plague, cholera, typhus, diphtheria and many others. In all of them there is the introduction of a living germ or germs; then a period of "incubation" or hatching, in which nothing can be observed; then follows the active disturbance, and, in the diseases, as well as in the fermentation of the sugary liquid, the process is stopped when the microbes have multiplied to a certain extent, a temporary or permanent protection being the result. Another name for diseases of this kind is "infective." A disease like smallpox or measles which can be passed from person to person without immediate contact between the two, is termed "infectious." In these cases the infection is conveyed by mucus expectorated by the first patient, or by dust blown about or carried in clothing, &c. Such diseases may also, of course, be communicated by direct contact. If direct contact between the sick and well is indispensable for the conveyance of a disease, it is called "contagious." In nature there is no such hard line drawn between contagion and infection, although some diseases can be more easily communicated than others. In this sense, then, the word "infectious" includes all the germ-caused diseases, however spread.

Throughout the progress of these diseases, except in the period of incubation, the patient is able to communicate his disease to persons about him who have not been rendered safe by a previous attack. The way in which he thus communicates his disease varies in different cases. In scarlet fever, the throat, nose, ears and skin are the chief sources of contagion ; in diphtheria, influenza, measles and whooping cough, the secretions from the throat and respiratory passages ; in enteric fever and cholera, the urine, stools and vomit. The protection afforded by one attack of an infective disease against its recurrence varies greatly ; speaking generally, they occur but once, but second attacks are not uncommon.

5. Means of Infection.—The modes by which infection is received vary greatly with different diseases ; the chief channels of infection are the skin and the mucous membranes, particularly of the digestive and respiratory tracts. This means, man can contract infection by means of cuts, scratches or wounds of the skin (inoculation), by means of the air and by means of food and drink. Under the last head, milk and water are the two usual sources of infection, but uncooked food, especially oysters and mussels fed in sewage-polluted waters, may produce the same effect. Cholera, enteric fever and dysentery are the chief diseases from this source. Milk may be infected from having been handled by an infectious person, or it may convey infection of some disease from which the cow or other animal yielding the milk at the time is suffering, as, for instance, tuberculosis. Water may be contaminated with sewage, or the excreta of a single infectious person. When the air acts as a conveyor of infection, the infectious matter must generally be in the condition of dust. In this manner the contagion of smallpox can be carried considerable distances, that of tubercle possibly only a short space, and that of typhus but a few feet. Of diseases spread by inoculation or damage to the skin, notable examples are tetanus or lockjaw following the fouling of wounds with earth, malaria and yellow fever resulting from bites of mosquitoes, plague from bites of fleas from rats, and sleeping sickness from the bites of a special fly found in various parts of Africa.

6. Susceptibility to Infection.—It may be asked, naturally, if, then, these disease-causing germs are so widely scattered and can reach man in such a variety of ways, why is it that man is not infected oftener than he is ? The answer is that persons vary in susceptibility to attack by different infective diseases ; moreover, the possibility and intensity of an attack depend on the condition of the person, and on the number and virulence of the particular microbes infecting the person. The main protection against infection by germs exists in man's own body, more particularly in the blood, whose white corpuscles swallow up and destroy a certain number of bacteria after they have been damaged by means of a chemical substance dissolved in the watery part of the blood. This protective action varies in different persons, and in the same person at different times, the most important disturbing factors being age,

fatigue, injury, exposure to climate and errors in eating or drinking. As long as a person keeps fit and leads a wholesome life under wholesome surroundings, this protective action is at its best; but when the vitality of the individual is lowered or the dose of infection is excessive, then the protection is proportionately overcome. The influence of age upon liability to infection by certain diseases is well known, notably in respect of enteric fever, which prevails more among young adults than among those of maturer age. So, again, fatigue or exhaustion plays a large part in rendering men susceptible to infection, especially that of enteric fever. This has been demonstrated experimentally, and there can be no doubt that much of the excessive incidence of this disease among young soldiers on field service can be explained by their greater susceptibility following exhaustion, fatigue and the general stress of campaigning. The same can be said of both injury and exposure to variation or change of climate. We see this constantly in the greater prevalence of enteric fever among new arrivals in India. This is not the result of chance, but the outcome of their translation from a temperate to a more or less tropical climate, whereby their physiological equilibrium is profoundly disturbed, involving a corresponding loss of their natural ability to resist infection. Among the various dietetic errors and indiscretions which sensibly lower the vitality and healthy condition of the human body, the foremost place must be given to alcoholic excess. The number of persons who contract infection by germs following the abuse of alcohol is much larger than many suppose, and in support of this view many interesting experiments have been made on animals. Thus, the disease-resisting power of the dog and pigeon against tetanus bacteria is so great that even large injections of these germs fail to affect them; but both the dog and the pigeon are quickly killed by tetanus if twenty hours before injecting the bacteria the animal or bird be given a dose of whisky. In the same way, certain breeds of sheep are unaffected by anthrax germs, but this power to resist infection by this disease is taken away from the sheep by giving them alcohol.

CHAPTER II.

THE PRINCIPLES OF DISEASE PREVENTION.

7. From what has been explained concerning the nature of disease, and the manner in which the causes act, it follows that the prevention of these diseases must include (1) measures to maintain or increase the resisting powers of the individual; and (2) measures to prevent or lessen the possibilities of disease-germs entering the body. Among the former, a prominent place must be given to

protective inoculations, while among the latter measures are such matters as personal cleanliness, clean air, clean barrack-rooms, clean food, clean water and clean and wholesome camps. Further, there must be some system by which organized sanitary effort in the Army is to be carried out to secure these details.

8. **Protective Inoculation.**—Mention has been made of the fact that in the case of the majority of the communicable or preventable diseases infection does not occur commonly a second time, notable examples in which this is the case being enteric fever and smallpox. This being so, the question suggests itself, why should not men be given or put in the way of acquiring a mild form of disease such as these, so that future infection of a severer nature may be rendered improbable if not impossible? In the case of smallpox the inoculation of people with the disease was practised formerly, in the hope of giving them a mild form of the infection and so preventing the occurrence of severe cases. Owing to faulty methods of inoculation, severe cases did occur, and the disease got so much out of hand that the practice of inoculation with smallpox had to be forbidden. Its place is now taken by the modern procedure of vaccination. This is really nothing but the inoculation or infecting of human beings with the germ of smallpox after it has been through the cow or calf. In other words, the cow or calf is infected with human smallpox. This does not make the animal ill; all that follows is the appearance of some blisters and sores on the animal, which yield a juice or lymph which, if inoculated (vaccination) into man, confers on him an ability to resist infection by the human smallpox. A very similar train of events occurs in the case of diphtheria in the horse. If inoculated with diphtheria germs, the animal does not get ill, but manufactures in its blood an antidote (antitoxin) to the diphtheria germs and their poison. If the animal be bled judiciously, its blood yields a watery fluid, rich in antitoxin, which, if injected into man, exercises both a preventive and curative influence on him against the human disease. The same idea is present in the attempts to ward off infection by enteric fever by injecting the killed germs into man, causing thereby the infected person to manufacture sufficient antitoxin to enable him to resist infection by natural means. The procedure is being constantly carried out in the Army, but, unfortunately, the protection against enteric infection which it gives is not as lasting or as complete as was hoped it would be. As a matter of fact, the protection lasts only some two years; but even so, it is something worth having, especially if it covers or tides a young soldier over a critical or dangerous period, when his powers of resistance to the disease are likely to be at their lowest and the chances of infection are likely to be at their highest.

It must be admitted that our ability to prevent or ward off infection from diseases of an infective nature by means of preventive inoculations is limited; still the principle is right and founded on scientific facts, and, as our knowledge becomes greater, will extend. Failing, then, a complete scheme of protection

against all the infective diseases by means of preventive inoculations, on what must we depend? Obviously, on a rational and wholesome mode of life, clean air, clean food, clean water and cleanly surroundings as attainable by a proper removal of filth and waste materials, combined with the organized control and management of the infected, and the disinfection of their infected clothing, products and surroundings.

9. Personal Cleanliness.—This is of the highest importance and involves not only attention to the skin, but to the hair, nails, mouth, and other parts of the body. The skin is a covering for protection, and for getting rid of water in the form of sweat. This latter function is increased by exercise as well as by other causes. If sweat be allowed continually to remain and dry on the surface of the skin, or soak into the clothing, it soon becomes irritating, unhealthy, and offensive. For these reasons we wash our bodies to remove, not only coarse dirt which we can see, but also the dried sweat which we cannot see. The act of washing further improves the skin, opens and cleans its pores and keeps it sweet and healthy. Most persons wash their hands and faces, but often forget parts covered by clothes. Of these, the following should be washed every day when possible : (1) between the legs and buttocks ; (2) the armpits ; (3) the feet and toes. In addition to this daily washing, a bath once or twice a week is necessary, but a bath should not be taken within two hours of a meal. After bathing or washing, the skin should be well rubbed and dried, as this prevents a chill and improves the circulation of the blood. Hands should always be washed before eating, and when washing the hands care should be taken to trim and clean the nails. It is an important and simple matter to keep the nails clean and in good order ; the finger-nails should be cut round and the toe-nails straight across. Dirty nails and fingers are a common means of conveying infection.

The hair must be kept closely cut, be brushed and combed daily, and frequently washed. Pomades and grease are, as a rule, unnecessary. The mouth should be kept scrupulously clean, and the teeth cleaned at least once, if possible twice, a day by rubbing with a brush. The best time to use the tooth-brush is before going to bed, so as to remove particles of food adhering to the teeth after the evening meal. The mouth should be washed out with water both morning and evening. Decaying or painful teeth ought to be reported to the medical officer. Often the gums are soft and inclined to bleed ; because this is the case one must not cease to clean the teeth ; to those unaccustomed to use a tooth-brush regularly its employment may at first cause a little inconvenience, but continued use will harden the gums.

Closely connected with the care of the skin is clean clothing. Dirt from the clothes reaches the skin, and dirt and sweat from the skin soak into the clothing. For these reasons, it is important to change and wash underclothing at least once a week. The same clothes should not be worn by day and by night. Socks get dirty very quickly. Every cadet should try and have two pairs in use, one

for the morning and one for the evening wear ; there should be also two pairs for the wash. Unless care be taken in attention to details of this kind, it is impossible to keep the feet hard and clean. Underclothes as well as overclothes can be cleaned by brushing, shaking, and exposing to the air and sun. This is nearly always possible, even when washing cannot be managed, as, for instance, in camp and on the line of march. An article of kit which is often neglected is the hair-brush. It should be washed every three weeks or so. Soap or hot water should not be used, but the brush rinsed in a basin of cold water to which has been added a teaspoonful of washing soda ; this will remove all dirt and grease. Dry it by shaking or swinging it round, and place it to dry in the sun or wind.

10. Clean Air.—The importance of pure, clean and fresh air cannot be over-estimated. Air is fouled by the breath we breathe from our lungs, by the effects of artificial lights, such as candles, lamps and gas, by the products given off by fires and other burning material, by the breath of animals and by dust or other dirt lying about and collected in rooms and passage ways. To correct this constant fouling of the air in rooms and other inhabited places, provision has to be made to admit a constant stream of fresh air, and to pass out the foul or dirty air. For these purposes, windows and various ventilator openings are provided, and it is important to see that some are constantly open to allow the air to circulate in and out. There is no need to open these apertures to such an extent as to cause unpleasant draughts, because, by the exercise of a little commonsense, sufficient opening can be provided to let in sufficient fresh air without creating draughts. On the other hand, for fear of causing draughts, windows and ventilators must not be kept closed or blocked with paper and rags. A window is best kept open by lowering the upper sash some three inches ; this will allow the incoming air to be directed well above the heads of the occupants of a room. Where an open fire is burning in a grate, this sets up a means of ventilation by drawing foul air up the chimney. Apart from securing clean air from the outside of a room or ward, much can be done to keep the air clean and sweet by keeping the person and clothing clean, as well as by taking care to prevent dust and dirt accumulating on floors, walls, shelves, cupboards, boxes, bedding and benches. When possible, windows should be kept open all day, and the upper sashes open at least three inches at night, all the year round. The surest test of a room being properly ventilated and its air being clean and wholesome, is furnished by its being free from smell and stuffiness ro anyone entering suddenly from the outside fresh air. It must be vemembered that the constant breathing of foul air lowers the itality of the body and so favours the possibility of infection by germs.

11. The desirability of keeping a room specially set apart for meals is now well recognized, and, when the accommodation permits, usually adhered to. The following rules should be observed : (1) No food should be stored or kept in barrack

rooms or wards. If it must be kept there, it should be placed in a covered jar or other receptacle. (2) The hands and clothes of all persons who handle food or cooking utensils should be scrupulously clean. (3) All bread and meat stores should be kept clean, tidy, ventilated, and not only free from, but rendered inaccessible to flies. (4) The kitchens and all fittings, such as tables, safes, shelves, as well as cooking utensils should be clean. Cooks and their assistants must be personally clean, and wear clean, washable over-clothing. As flies carry minute portions of filth and germs on their feet, contaminating all they touch, they should not be allowed to gain access to kitchens. Flies breed only in filth, and where there are many flies it is a certain sign that there is filth and dirt in the near neighbourhood. (5) Mess-orderly cadets should be personally clean, and not allowed to act as such, or in any capacity connected with the serving of food, if recently recovering from any infective disease, but more especially from enteric fever. All cooks and their assistants must be supplied with a sufficiency of clean towels for washing up. All cans, dishes, plates, mugs, knives, forks, tubs and other utensils used at meal times or for food storage should be scoured and cleaned on a table, and not placed on the floor or taken to outside taps. Utensils of this nature should be washed in a large tin or tub reserved and marked for this and no other purpose. All cloths used in the cook-houses or sculleries must be washed daily and dried. For scouring of tea-cans, meat-dishes, knives and forks, clean bath-brick shaken from a tin kept for the purpose alone should be used. The use of casually collected sand must be forbidden for this scouring work.

12. Closely associated with the cleanliness of barracks and the health of the occupants is the proper *disposal of refuse*, and the use and care of urinals and latrines. Kitchen refuse must invariably be placed in the special receptacles provided. As far as possible liquid refuse should be kept distinct from the dry or solid material; but in both cases the receptacles must be kept covered in order to avoid smells and to prevent the access of flies to the contents. Its removal from barracks must be performed daily. Paper and other rubbish must be placed in the receptacles provided, and whenever possible these should be kept closed. General untidiness quickly follows any failure to attend to this detail.

13. *Latrine* accommodation in barracks is on a sufficiently liberal scale. The proper use and care of these sanitary conveniences are matters of the first importance, as, if neglected, these places rapidly become centres for infection. In most barracks at home, water carriage of sewage is available and the type of closet of a simple nature; in these water-closets, the flushing is done either automatically or by hand. In the newer barracks, ordinary water-closets with individual flush-tanks are provided, and it is the duty of every user of these closets, not only so to seat himself that he does not unnecessarily foul the seat, but also to see that the contents of the pan are properly washed away by pulling the chain of the flushing tank. Another detail requiring attention is that of using

paper torn or cut to a size not larger than that of an ordinary hand. In all well-regulated barracks suitable toilet paper is provided, but in spite of this, it is not unusual to find large sheets of newspaper thrown into the closet pans. The very bulkiness of these masses of paper prevents the pan being properly cleaned and facilitates rapid clogging up of the discharge pipe. For the same reason pieces of cloth, rags, boot-laces, string and other articles of the kind must never be thrown into a closet, the proper place for these waste products is the ash-bin.

In a few places at home and in most garrisons abroad, the dry-earth closet exists; the usual arrangement being the provision of a pail or portable midden placed under apertures in a well-fitted seat, with boxes of dry earth from which, by means of a scoop, the user covers over the excreta. The pail contents must be removed daily. As in the case of water closets, the user must take care not to foul the seat, and take special care to throw a sufficiency of the dry earth available over the filth in the pail. The object of this is to remove the smell and to prevent flies gaining access to this objectionable material.

14. No matter whether it be a water-closet or a dry-earth closet, all woodwork and fittings must be kept scrupulously clean. The seats must be scrubbed daily with soap and water, the scrubbing to embrace both upper and under surfaces of the seat. The pans or pails must be kept clean, and every collection of filth must be covered with either water or earth. Where earth-closets are in use the proper employment of the earth must be enforced, and an adequate supply of finely powdered dry soil and a sufficiency of scoops must always be available. The pails must be of a size to fit closely under the seat. There should be no gap or space between the top of the pail and the seat; if there is, it means certain fouling of the floor with urine or other matter. The latrine floor must be suitably sloped, and made of some hard impermeable material. A sufficiency of pails must be available, so as to allow those which have been fouled to be cleaned and sweetened. This will be best secured by first washing out the contents with water, drying and airing by exposure for a few hours to the sun if possible, and then scrubbing over the inner surface with the heavy cresol oil supplied for the purpose by the barrack department. The coating of these utensils with tar is most objectionable, as it renders them unsightly and tends to conceal rather than remove dirt. The contents of each pail must be transferred without spilling to a suitably covered water and airtight receptacle for daily removal.

15. *Urinals* need to be managed on similar lines. The slabs of slate or glazed earthenware must be adequately flushed with water either automatically or by hand, and twice a week scrubbed over with the heavy cresol oil supplied for the purpose. This does not need to be applied in excess; just sufficient to impart a greasy surface is ample. Well managed latrines and urinals should be devoid of smell and free from flies, even in warm weather. The

presence of flies in these places is a sure sign that something is wrong. Urine tubs, if in use, must be treated in precisely the same way as closet pails. Their contents need to be carefully emptied each morning, with special precautions taken to see that no splashing or spilling occurs. If such does occur it should be immediately dusted over with dry earth and the place swept clean. All cadets engaged in the handling of urine tubs or in the care and cleaning of urinals, closets, or latrines must remember that they are handling dangerous material capable of giving infection to either themselves or others, often both. To reduce these risks to the lowest point, cadets engaged on these duties should carefully wash their hands immediately on completion of the work, and certainly before they handle food. No cadets employed in cook-houses or as mess-orderlies should ever be allowed to have anything to do with the removal of urine tubs or with the care and cleansing of urinals or latrines ; further, it is advisable that no cadets who have ever suffered from enteric fever should be employed in either the preparing or serving of food.

CHAPTER III.

THE CONTROL OF INFECTION.

16. The occurrence of a case of infectious disease calls for prompt measures to be taken (1) to find out how and why it has occurred ; (2) to safeguard or prevent its extension to others. These are essentially matters of executive by the medical corps, and the greatest importance attaches to their faithful performance.

The first step to be taken is that of isolation, segregation, or the separation of the sufferer from others not similarly attacked. It may be necessary to isolate or arrange for the segregation of others who may have been exposed to infection. The term infectious disease, as applied to the preceding requirements, includes smallpox, measles, diphtheria, scarlet fever, typhus fever, enteric fever, cholera, yellow fever, plague and erysipelas.

The second step must be the careful collection of all clothing, bedding and other articles which have been used or presumably infected by the infected person. These should be carefully set aside and promptly despatched for disinfection by steam.

17. Notification of infectious disease will include the occurrence not only of those enumerated above as requiring prompt isolation, but also the following, namely, cerebro-spinal fever, Malta fever, puerperal pyæmia, puerperal septicæmia and tuberculosis of the lungs, larynx, or intestine. In some cases it may be desirable to carry out isolation in these diseases also, but this discretion rests with the officer in medical charge of or reporting the case, on whom

primarily rests the responsibility of carrying out these initial steps for the control of infection.

Complementary to these precautions is the necessity for prompt inquiry, not only of the infected person but also of his associates, as to movements, habits and possible sources of infection having arisen through water and food, more particularly shell-fish, water-cress, lettuces, milk and other articles eaten in an uncooked state. The evidence forthcoming is often negative, but cannot be ignored, and wherever there is reason for doubt or suspicion, all these possible sources of infection should be looked into and personally verified by either the sanitary officer or the medical officer originally reporting the case. Action on these lines must be prompt and never deferred.

18. Disinfection.—There remains one other procedure to be considered in detail; it has already been referred to. Disinfection means the application of some procedure to kill or destroy actual germs of disease. The mere removal of a smell or the delaying of the growth of bacteria is not disinfection.

Disinfection may be effected in a variety of ways, but practically disinfectants are employed for one or other of the following purposes:—(1) to disinfect the clothing and bedding used or soiled by infected persons; (2) to disinfect the rooms or places occupied by infected persons; (3) to disinfect discharges from infected persons.

19. *Cotton and linen goods*, such as sheets, pillow-slips and shirts, are readily disinfected by boiling. Before despatching them to the laundry for this purpose or in cases where boiling of these articles is not practicable, they should be soaked for half an hour in a 2½ per cent. cresol solution, made by taking 1½ fluid ounces of liquor cresoli saponatus fortis and diluting to one gallon.

20. *Blankets and woollen articles*, when suspected of serious infection, should be disinfected by steam in a proper disinfecting apparatus; but if only dirty and not under suspicion of infection, they may be soaked in cresol solution for half an hour and then sent to the laundry.

21. *Mattresses and pillows* are frequently seriously fouled and often awkward articles to disinfect and handle. They should be thoroughly well sprayed with a solution of formaldehyde, made by diluting eight fluid ounces of formalin solution to one gallon. The articles should be efficiently sprayed on all surfaces, then rolled up and taken to the disinfecting apparatus for disinfection by steam. When no steam-disinfector is available, mattresses and pillows should be opened up, and the stuffing as well as the covers well wetted with the formaldehyde solution.

22. *Cloth goods, uniform, and ordinary suits* should be disinfected by means of steam and removed to the disinfector for that purpose. Leather goods are not to be treated by steam, they are best disinfected by spraying with the formaldehyde solution, and should then be exposed to the air and dried. When steam-disinfection is not available, suits, overcoats, and cloth goods generally may be similarly

treated. All articles which do not admit of adequate disinfection should be destroyed by fire.

23. *Rooms or quarters* which have been occupied by infected persons can only be disinfected after the people have left them. The aim or object is the disinfection of all exposed surfaces, as on them germs are liable to be lodged or resting. The disinfection of the air in infected rooms is effected sufficiently by opening windows and admitting fresh air and sunlight. Except in the case of places which have been occupied for some time by those suffering from smallpox, scarlet fever, and tuberculosis of the lungs, or where three or more cases of an infectious disease have occurred in one room, it is rarely necessary to disinfect a room simply because a case of infectious disease has occurred among its occupants. The reason for this is the fact that the germs or causative agents of the majority of the infectious diseases attach themselves to the persons, bedding, clothing and other personal articles of the infected, and not to the walls, ceilings, fittings and floors of their rooms. In the majority of cases these latter can be rendered sanitarily safe by the exercise of free ventilation, admission of light and scrubbing with soap and water. Where rooms are very dirty, ceilings need to be whitewashed and the walls either re-papered or colour-washed.

There are four chief means of disinfecting room surfaces: (*a*) Dry rubbing the walls, &c., by means of bread or dough. This sterilizes them by mechanically removing microbes and germs of disease. The bread is cut into pieces suitable for grasping in the hand, the cut surface being applied to the ceiling, wall, &c. The crumbs must afterwards be carefully collected and burnt in the room itself. (*b*) Washing or scrubbing with soap and water or some ordinary disinfectant solution, as for instance the 2½ per cent. cresol solution already mentioned. This is an excellent way of dealing with floors, forms, tables and other wooden pieces of furniture, or washable surfaces. For walls and ceilings it is somewhat laborious and best replaced by spraying. (*c*) Spraying the ceilings, walls, floors and furniture with a disinfectant solution is a common and fairly convenient method of disinfecting surfaces. It is less laborious than dry rubbing or even wet rubbing, and less likely to damage paint or wall paper than brushing a disinfectant solution on them. But for all that, it is a slow procedure requiring much patience and time. A special spray apparatus is employed, the most effective disinfectant solution for the purpose being made by taking eight fluid ounces of formalin and making up to one gallon with water. This solution is effective if carefully applied; one gallon will suffice to spray some 400 square feet of surface, and care must be taken to see that patches are not left uncovered with the solution. The spray must be applied from below upwards, this secures an even application of the disinfectant and prevents the marking of the wall by streaks. The operator will experience some discomfort from the formaldehyde vapour giving rise to smarting of the eyes, but in time this effect wears off. On completion of the spraying of all surfaces in a room, all drawers and cupboard doors should be left

open and the apartment left closed for four hours, so as to allow the full effect of the vapour given off to be exercised on any germs which may be present. (*d*) Fumigation constitutes the remaining method of disinfecting a surface, and probably is the most easy and least troublesome mode. It can be carried out by a variety of chemical agents or gases, but that most commonly used in the army is sulphur dioxide.

When fumigation of a room has to be carried out, the measurements or size in cubic feet of the room must be taken. Next, all crevices, cracks, apertures and holes, not forgetting the throat of the fireplace chimney, must be carefully closed by pasting over with paper to prevent air or gas escaping. If this is not done the act of fumigation is more or less useless.

Sulphur dioxide can be generated by burning 3 lb. of sulphur in a metal dish or dishes for every thousand cubic feet of space in the room. The sulphur must be broken up and placed in a saucepan or other metal vessel, supported over a bucket of water, and its ignition aided by pouring some methylated spirit over the sulphur and then setting it alight. It is advisable to have a sufficiency of metal containers, so as to cause not more than one pound of the sulphur being burnt in any one dish. These vessels containing the sulphur should be evenly distributed over the room, and not all concentrated in the centre or any one part of the apartment. The same effect is secured by discharging the contents of specially prepared cylinders containing liquefied sulphurous acid gas; one 20-oz. cylinder of this compressed gas is sufficient for a space of a thousand cubic feet. The room must be left carefully closed and kept so for quite three hours. In using the cylinders of gas, the same care must be taken to distribute them equally through the room, as has been explained when using ordinary roll sulphur. Sulphur dioxide or sulphurous acid gas is not very reliable as a disinfectant; it has a low penetrating power and is more or less non-effective in very dry weather.

The disinfection of a room by means of spraying the walls with diluted formalin, or by fumigation with sulphur dioxide, will be carried out only when specially ordered. The usual procedure to be adopted when a case of infectious disease occurs is to remove all bedding and clothing and disinfect them by means of steam; on this being done, the floor for a distance of six feet all round the bed, the bedstead, chair, locker or other article of furniture used by the infected person will be scrubbed with a 2½ per cent. solution of cresol. Carpets, curtains, and other draperies will be sprayed with the formaldehyde solution, removed into the outer air, dried, dusted and shaken before being taken back into the room. If these procedures be carefully and intelligently carried out, it will be rarely necessary to limewash or distemper walls or ceilings, or to strip and renew wall papers of rooms after the occurrence of an infectious disease.

24. The *treatment of discharges from patients* is an important point in the control or management of infection. The stools or motions should be received into a bed-pan containing a 5 per cent.

solution of carbolic acid; a $2\frac{1}{2}$ per cent. solution of cresol or a 2 per cent. solution of either cyllin, izal or kerol. The urine and vomit, if any, must be treated in exactly the same way, taking care that an amount of the disinfectant solution, equal in bulk to that of the material to be disinfected, be added. In the case of motions or stools, this may be taken to be quite eight fluid ounces, and this same volume of disinfectant solution must be added and mixed with the excreta by means of a piece of stick. To urine and vomit, at least four ounces of the above solutions should be added each time, and well mixed. The urine from enteric fever patients should always be carefully disinfected. In circumstances when none of the disinfectant solutions are available, efficient disinfection of excreta or other discharges from the sick can be attained by pouring on to and well mixing with them plain boiling water. Hot water will not do, it must be boiling water.

25. *Discharges from the throat, nose and mouth* of patients should be received into any one of the above named disinfectant solutions. Pocket-handkerchiefs should be avoided if possible, using linen rags instead, which should be placed at once in one of the above solutions, or burnt.

26. The *skin* may scatter infection, especially in smallpox, chicken-pox and scarlet fever. Frequent baths and smearing over with vaseline or oil are useful.

27. The *disinfection of hands* is most important for all attendants on the infectious sick. The simplest means of securing this is the free use of the nail-brush with soap and hot water. In special cases, the hands may be cleansed in any of the above mentioned disinfectant solutions, or in a 1 in 1,000 solution of perchloride of mercury (corrosive sublimate). This is made by dissolving half an ounce of the perchloride in three gallons of water, adding one ounce of strong hydrochloric acid. It is best to colour this solution with either a little aniline blue or fuchsin; the colouring is added to avoid accidental poisoning and to serve as a warning.

CHAPTER IV.

WATER SUPPLIES.

28. The supply of wholesome water in sufficient quantity is a fundamental sanitary necessity. Without water, injury to health follows invariably either simply from deficiency of quantity, or more frequently from the presence of impurities.

29. Amount of water required.—In estimating the amount of water required daily for each person, it is necessary to allow a

liberal quantity. There must be avoidance of waste but still any error in supply had far better be on the side of excess. In civil communities the daily allowance per head of the population varies immensely, but includes water for municipal and trade purposes The average daily allowance per head in civil life is 30 gallons; in the army, 20 gallons per day are allowed for each adult, and 10 gallons for every child. For cadets living in camps, these figures need to be modified considerably. Under circumstances of stress one gallon per head daily might suffice; including animals, the lowest allowance may be put at three gallons per head each day. Apart from the difficulties experienced in supplying more, it is desirable not to exceed this amount in camps, as any excess means waste, with corresponding difficulties in surface drainage.

30. Sources of water supply.—All our water supplies are derived in the first instance from rain, which either lodges and lies on the surface of the earth or soaks and sinks into the ground according to the nature and arrangement of the soil. The water which lodges on the surface or top of the earth forms puddles, ponds, pools, lakes, ditches, and rivers. The water which soaks and sinks into the earth is the underground water, which we gain access to either by means of springs or wells. For these reasons, we may speak of the chief sources of water supply as being:—(1) rain; (2) surface waters from hills, or high lands, and that lying on top of the earth in ponds, pools, lakes, ditches, and rivers; (3) the underground waters cropping up to us as springs, or that obtained by means of borings, shafts, or wells. Each of these supplies may yield either clean or unclean water, according to the nature of the circumstances.

31. *Rainwater* approaches nearer to absolute purity than any other kind of natural water. When collected in clean vessels it contains only such dissolved substances as it can take up from the air. As it falls through the air, it becomes highly aerated, but in inland districts the amount of impurities which rain washes out of the air is often considerable. It is, however, mainly from the surfaces on which rain falls that the chief impurities result. These consist generally of bird droppings, decayed leaves, soot and such matters as collect on roofs, platforms, in gutters and receiving vessels. For these reasons, rainwater, as ordinarily collected, is impure and dirty, and its use as a supply for drinking purposes is only justified in places where no better source is available. The chief merit of rainwater is its softness, owing to the absence of salts of lime and magnesia. On this account it is good for washing or cooking purposes, although this very attribute of softness renders it less palatable than other kinds of water for drinking. Owing to its richness in dissolved air, rainwater has frequently a considerable action on lead. This is a feature of some importance in connection with pipes, fittings and cisterns or tanks to be used for its storage.

Apart from these drawbacks, rain as a general source of water supply is unsatisfactory, owing to the uncertainty of the rainfall,

the length of the dry season in many countries and the large size of the reservoirs which are then required.

The amount of water given by rain can be calculated easily if two facts are known, namely, the amount of rainfall and the area of the receiving surface. The rainfall can only be determined by a rain-gauge, the area of the receiving surface must be measured. A fall of one inch of rain delivers 4·6 gallons on every square yard or 22,617 gallons on each acre. All of this will not be available; some will sink into the ground and some will evaporate. The quantity lost in this way will vary with the soil and the season.

The utility of ice and snow water is very limited; moreover, its use is not free from danger, especially in the case of ice derived from polluted water. The mere act of freezing has a feeble effect in destroying bacteria and on this account because water has been frozen it cannot necessarily be deemed safe. In its general qualities, water derived from dew or melted snow may be regarded as similar to ordinary rain.

32. *Surface water* running off uplands or hills may be clean or dirty, according to the nature of the land or country over which it flows. Such water, running off hills over which neither man nor animal goes, will naturally be cleaner than similar water flowing over manured land or over country which men and animals frequent. The same must be said of other surface waters in pools, lakes, ditches, streams or rivers. Sometimes this water will be clean sometimes not, according to the nature of the banks and neighbouring country, and according to what opportunities exist for the filth of man and animals to gain access to it. As a rule, it may be assumed that water obtained from these sources is unclean. There are, of course, exceptions and each case must be judged on its merits, as disclosed by a scrutiny of local conditions. Many communities obtain safe water from upland surface supplies. But the gathering grounds are usually well safeguarded from casual pollution by adequate patrolling. Rivers are fed from such a variety of sources that the quality of the water they yield is extremely variable. A stream running through a sparsely occupied district will obviously be cleaner than one passing through a more densely populated area. Equally, facts as to local methods of sewage disposal will materially affect the opinion to be formed as to the probable quality of water yielded by a pool, pond, stream or river. The rule should be: *regard all surface waters with suspicion.*

33. *Underground water* is the vast volume of water which exists at varying depths below the earth's surface, representing the water which, having fallen as rain, has soaked through the soil layers The amount of, and facility of access to, water underground varies with the configuration and density of the earth's crust. In some places this water may be abundant at a depth of only a few feet, while elsewhere it may be scanty or only obtainable at considerable depths. Man gains access to this ground water either by springs or wells.

34. *Springs* are natural out-crops or overflows of the underground water. The rain which falls on a permeable soil percolates downward until it is arrested by a bed of clay or other impermeable stratum, and there becomes stored underground until it rises to a point of level at which it can appear spontaneously at the surface. Springs are found commonly on the side or foot of a hill, in valleys and near the beds of rivers. The water obtained from springs is usually good, though often hard and loaded with mineral salts such as lime, which have been dissolved out of the soil. Spring water is clear and bright, in consequence of the great degree of filtration which it naturally undergoes, in percolating through the soil layers, between the gathering ground and the point from which it issues again from the earth. Spring water is both pure and impure in different cases, and the mere fact of water being derived from a spring is not necessarily a guarantee of its goodness, though in the majority of cases it may be regarded as safe.

The yield of a spring is determined most readily by receiving the water into a vessel of known capacity and timing the rate of filling. The spring should have been opened up previously, and the receptacle employed should be of large size. In cases where a spring yields a steady but small volume of water, an increased supply may be frequently obtained by digging out the spring head. The chief risk attaching to springs is the facility of pollution of the issuing water by surface washing; hence, when used for any length of time, a spring should be enclosed, its level raised, and the ground made to slope away from rather than towards it. If this is impracticable, the vicinity should be so ditched that all surface drainage from higher ground is intercepted and conducted to a point below the level of the spring.

35. *Wells* may be divided into two classes, shallow and deep; in both cases they represent shafts or borings sunk by man to tap or gain access to the underground water. Shallow wells draw their water supply from the subsoil, while deep wells tap the water-bearing layer beneath some impervious soil stratum which separates it from the subsoil above. By far the larger number of wells met with belong to the first class. Shallow wells may yield good water provided there is no risk of pollution from surface washings or from their proximity to cesspools or leaky drains. In or near towns, villages, or farmyards this pollution is very liable to occur, so much so that the water from shallow wells, say from ten to fifty feet deep, is always to be regarded with suspicion. The distance drained by wells is undetermined, the area varying with the nature and porosity of the soil, but in the majority of cases the radius of the area drained is equal to four times the depth, at least, and may even exceed this. A porous soil, with no impervious superficial stratum, will admit of impurities reaching a well from the surface which a clay soil would shut off. The movement and course of the ground-water being in the direction of the nearest watercourse or the sea, to protect the water supply from any soakage from leaky drains or cesspools in the vicinity, a well should

be placed above all such possible sources of contamination. A well which yields a moderate quantity of good water may, if the demand on it be increased, draw in water from the surrounding parts, and thus tap sources of impurity which a moderate demand left untouched. A sudden rise in the ground water, as after heavy rain, may lead to direct communication between a cesspool and a well, by the water tapping the former in its flow.

In some cases a well at a lower level may receive the drainage of surrounding hills flowing down to it from great distances. Good coping stones, so as to protect from surface washings, and good masonry for several feet below the surface of wells in very loose soils, so as to prevent superficial soakage, are necessary in all shallow wells. In the majority of cases where shallow wells yield polluted water, this is due to defects in their construction. The growth of trees should not be encouraged in the vicinity of wells, as their roots are apt to cause facilities for the inlet of surface water. For similar reasons, moles and rats should be prevented from burrowing near wells.

Deep wells, artesian and tube wells, are generally of great depth, passing through an impermeable stratum, such as clay or rock, and penetrating a water-bearing soil which crops up elsewhere at some higher point, and below which again is another impermeable stratum. From the nature of these facts, it is easy to understand that the water from those deep wells or borings is nearly always good. Like the shallow wells, these must be adequately protected at the surface to avoid pollution at that point.

36. *Distilled water* needs a short reference, as distillation is one of the most effectual modes of freeing water from impurities. On board ships, distillation of sea water is resorted to in order to render salt water fit for drinking; and although the water thus obtained is pure, yet, all the gases having been driven from it by the boiling, it is unpalatable, and by some supposed to be indigestible. Distilled water may be aerated by allowing it to trickle slowly down through a long column of wood-charcoal, or by filtration through some porous substance. In all distillation apparatus, care needs to be taken that the distilled water is not left in contact with lead, zinc or copper fittings, as the water has a curious ability to dissolve and attack these metals.

37. Comparative qualities of water supplies.—This depends on many circumstances. Rainwater, if properly collected and stored, affords an excellent supply when other sources are not available, especially in country or sparsely populated areas. The uncertainty of the supply often necessitates a considerable storage capacity; this is not very desirable. Rainwater should be clarified or filtered to remove suspended matters before being stored, and the tanks protected from surface or other workings, also from light and heat. Spring-water is usually good, but there are cases in which a spring may yield bad water. Much depends upon the geological formation and how well the spring is protected from surface pollution. When springs arise from sand or gravel the

immediate neighbourhood needs careful scrutiny; as a rule, from two to five acres above and around a spring should be free from all manurial matter, and that portion of the area immediately affecting the spring should be enclosed to prevent access of men and animals. If heavy rainfall renders a spring-water turbid, it is highly suggestive that the source is unsatisfactory. Shallow well water is always to be viewed with suspicion; the same must be said of most river water, as a river is the natural point to which the drainage of a good deal of surrounding land tends, and heavy rains will often wash many substances into it. Apart from this, few rivers are free from the discharge into them of much objectionable matter, if not actual sewage. Upland surface-waters are, as a rule, safe, but much depends upon the presence or absence of houses, flocks or herds of animals and adequate policing of the collecting area.

38. Storage and Delivery.—The methods of storing and delivering water will vary with its source. In upland surface schemes, storage reservoirs are a necessity to equalize the supply and demand; in all cases these collections of water are best left uncovered, but suitably protected from the access of men and animals. They need periodical cleaning.

When water is obtained from a river, the intake should be placed where a good stream is constantly flowing; stagnant and shallow parts should be avoided. The water is best taken some three feet below the surface. If storage is required, reservoirs will need to be constructed. River water undergoes notable improvement during storage in large reservoirs, and all experience shows that the larger the storage reservoirs and the longer the water can be retained in them, the greater is the self-purification obtained.

Occasionally, rainwater collected from the roofs of buildings is the only available source of supply. The storage of this water is of importance, but it needs care, as it has an erosive and solvent action on lead. For this reason rainwater storage tanks are best made of slate or galvanized iron. The tanks must be well protected by covers, ventilated, and periodically cleaned out.

In all water schemes, the water must, if possible, be conducted in pipes from the reservoirs or other sources of supply to barracks. In camps, this is equally desirable, but not always possible. Distribution by hand or by open channels is crude and objectionable, for it is impossible to guard altogether from casual contamination. If hand-carriage is unavoidable it should be done only by means of tanks on wheels, provided with covers which should be kept closed down. These movable tanks need periodical cleaning just the same as fixed tanks. The best way of cleaning tanks is to fill them with water, add sufficient permanganate of potash crystals to make the water a blood-red colour, allow it to stand for six hours, and then empty. In barracks, cisterns are often provided; these must be kept covered, ventilated, and periodically cleaned. Each such cistern must have an overflow pipe, discharging into the open air and well away from all drain gullies. A cistern supplying a water-closet should not be used to supply cooking and drinking water, as

the pipes leading to the closet often conduct closet air to the cistern. Hence a small cistern should be used for the flushing requirements of each closet.

39. Impurities in Water.—The impurities which gain access to water and so render it unclean are various. Some reach the water at its source, some during its storage and some during its distribution. No matter how or where these impurities reach water, they exist practically in two states or conditions; they are either dissolved in the water, that is in solution, or they are merely floating in the water, that is in suspension. Experience has taught us that the various substances which are dissolved in ordinary waters are not, as a rule, hurtful; it is otherwise, however, with the suspended matter in waters. This suspended material is the true impurity in most waters, and may be in the form of fine sand, clay, grit or mud, that is, suspended matter which we can see with our unaided eyes; or it may be germs or similar living substances which, although floating and suspended in the water, are so small that they are not to be seen by the naked eye. In other words, an absolutely clear and crystal-like water may be full of harmful germs and most hurtful to anyone drinking it. As a matter of fact, the visible and invisible suspended impurities in water are usually associated, and it is rare to find one without the other; but it is important to remember that it may be otherwise. It is, then, the suspended impurities in water which we have to fear as giving rise to disease. How the minute and invisible germs do so has been explained. The coarser suspended matter in the form of sand and grit is only a degree less harmful; if this matter be taken into the body, it acts as an irritant to the lining membrane of the bowel, irritates and renders it inflamed; of itself, perhaps, this will not cause actual disease, but as this material is usually associated with harmful germs, the damage done to the bowel surface favours their penetration and entry into the blood and consequent ability to give rise to infection. In this manner, coarse dirt and mud, though not itself causing infection, sets up conditions in the body favouring infection by germs in the water.

40. Effects of drinking impure water.—The diseases which are associated with the use of impure water are cholera, enteric fever, dysentery, diarrhœa, parasitic intestinal worms and some obscure forms of metallic poisoning. The virulence of a water-borne disease has some definite relation to the original purity of the supply, for, once seeded with the specific germs, a dirty water appears to act more virulently than one that was originally clean. From our knowledge of the history of infective micro-organisms it would appear doubtful whether they survive in good water for any lengthened period. Laboratory experiments show that from 14 to 40 days has been the maximum period of their vitality, and probably under less favourable conditions a much shorter period would complete their life.

The intimate association of both cholera and enteric fever with foul water is beyond dispute. In both diseases, the specific germs

gain access to the water by the discharges of those suffering from these diseases being allowed to enter defective drains, etc., the contents of which infect the subsoil water or are carried direct into rivers or streams from which drinking water is taken. That dysentery is caused by the drinking of impure water, there is ample evidence; in nearly every instance the water was polluted with fæcal or dysenteric discharges, and where the supply was discontinued the disease disappeared. It may also be said that diarrhœa among soldiers has frequently been caused by the fine or gross suspended mineral matters in water. These act as mechanical irritants to the bowel, and a bowel so damaged is consequently placed in an eminently receptive state for infection by various virulent germs, should they be swallowed subsequently. The ova or eggs of various parasitic intestinal worms are frequently found in water, particularly in the tropics; their presence and ingestion by man constitutes one of the channels of this kind of infection. Metallic poisoning may result from the absorption by water of the metal used in the making of service pipes, cisterns, &c. The water may also be contaminated at its source by passing through a soil in which a metal is present, as in some mining districts. Copper, lead, zinc and arsenic are the most probable poisonous metals which may gain access to water in this way.

CHAPTER V.

PURIFICATION OF WATER.

41. If it is realized what are the impurities likely to be met with in water, the principles on which and the practice by which they are to be removed will be readily understood. It may be accepted that it is not necessary to trouble about what is in solution, but aim simply to remove or render harmless that which is really suspended in water. This may be either coarse mineral grit sand and mud, which is more or less obvious to the naked eye, or it may be germs and similar living bodies, which although floating and suspended in water, are so small that they are not to be seen by the unaided eye. A variety of procedures have been suggested and used for these purposes, and their applicability depends much upon whether it is intended to purify water in bulk or large volumes or whether the act of purification is to be applied to small quantities only. In civil life it is the exception rather than the rule for water to be purified in small quantities by the consumer, owing to the fact that water is nearly always submitted to some process of purification by the companies before distribution to the public. In military life it is rare to find any organized attempt made to purify water in bulk, but if it is of indifferent quality the act of purification is applied to relatively small quantities only. As suitable for the various conditions of army life, there are four main methods by which water can be purified, namely, clarification, filtration, sterilization by

heat and sterilization by chemicals. Each of these methods has its advantages and disadvantages, and may be employed separately or in combination.

42. Clarification.—This is the simplest and often the readiest method which can be applied for rendering dirty water reasonably safe. Clarification or coarse straining of water removes only the mud and grosser impurities, and unless very specially conducted fails to remove the smaller suspended particles such as germs. In spite of this limitation, clarification is a procedure always worth doing; far better to do this much than do nothing at all, while as a prelimary procedure it has the greatest value.

The simplest way of accomplishing clarification is to pass the water through blanket or canvas sacking or canvas stretched on an improvised wooden frame, dusting over the fabric ordinary wood ashes from a camp fire. The strained water is received in any suitable receptacle placed beneath. If the water is not sufficiently cleaned it may be passed again through the strainer or through another one conveniently placed. The straining power of devices of this nature can be much increased if alum be added to the water before being poured on to the fabric. The alum forms gelatinous particles in the water and on the straining surface which entangle and hold back the suspended matter. An alternative device may well take the form of a canvas cone attached to a metal ring, having cords by which it can be hung from a tree branch. Such an improvized strainer can be used with or without wood-ashes or alum, and provided too much hurry is not exercised or the water not made to pass through too rapidly, it can and will remove not only coarse mud but a great portion of the associated germs; by this means otherwise undrinkable water can often be rendered reasonably safe. Many occasions on field service afford opportunities for the exercise of initiative on those lines, which can and should be turned to good account by the soldier.

43. Another simple way of securing quick clarification, especially of river water, consists in digging a pit near the proposed source of supply, so that the water may percolate through the soil before being used; the arrangement will work better if time be allowed for the water to settle, and, when water is withdrawn, care must be taken not to stir up the mud.

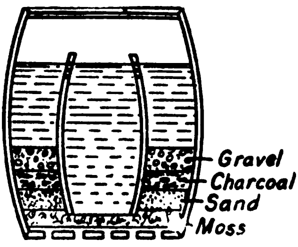

FIG. 2.—IMPROVIZED BARREL-FILTER.

44. If two barrels of unequal size be available, one may be placed inside the other and the interspace filled with clean sand or wood-ashes. The outer barrel bottom is pierced with small holes, and the inner barrel similarly pierced round its upper rim. If the whole be partially submerged in the water to be cleared, an excellent supply of clean water can be obtained by suction from the inner barrel (Fig. 2). When the supply is smaller, this method may be reversed, the space between the barrels being partially filled with clarifying material and the bottom of the inner barrel either removed or better

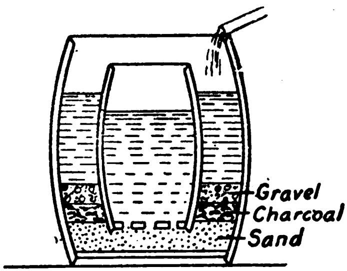

FIG. 3.—IMPROVIZED BARREL-FILTER.

still perforated with holes. If water be poured into the outer barrel on to the straining material it will percolate down through this and rise to its proper level in the inner barrel, whence it can be withdrawn (Fig. 3). Care must be taken to ram the straining material down, and to fix the inner barrel firmly in and hold it there till the weight of water within it is sufficient to keep it in position.

45. An effective strainer may be improvized by boring a small hole in the bottom of a barrel or other suitable receptacle, and partially filling the latter with layers of gravel, fine sand and wood-ashes in this sequence. The gravel should be three inches in depth and the sand some twelve to fifteen inches deep, with some three inches of wood-ashes on the top. These thicknesses can be increased if the receptacle is large enough. The water to be clarified is poured in at the top, passes down through these layers, and is collected as it emerges from the hole in the bottom. On first using, the water will not be satisfactory, owing to the materials not having settled down, but on continued use the quality of the strained water will improve as the straining mass ripens. Periodically, the material will need cleansing and changing. The success of these methods depends largely upon not attempting to pass the water through too rapidly ; usually the working head or layer of dirty water on the top will be found to give best results if not exceeding six inches in depth.

In improvizing strainers or clarifiers of the above types, care must be taken to get real sand, and not use sandy marl in which there is much clay. This latter, when wetted, binds and forms so dense a mass that percolation of water is slow and often absent. It must further be remembered that all improvizations of the kind are mere makeshifts and, unless the material be periodically renewed and the water not allowed to rush through too quickly, may be a source of danger. The addition of a small amount of alum is an advantage, since it produces a jelly-like precipitate which helps in arresting and entangling the more minute particles held in suspension.

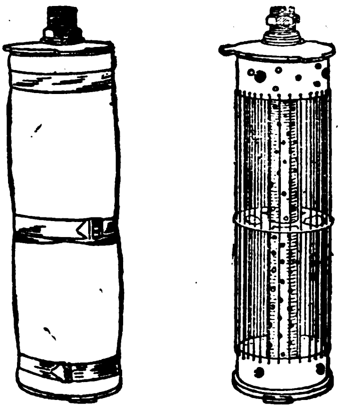

FIG. 4.—CAGE AND FLANNELETTE STRAINER.

46. A more elaborate arrangement, and one well suited for fixed posts or camps, is that of making a stout wire cage (Fig. 4) and rolling round it the best and stoutest flannelette which can be obtained, and securing this firmly by means of broad tapes. The flannelette should be applied not less than four folds thick round the wire drum or cage. This strainer has a central axis or perforated tube closed at one end, but discharging through the other end-plate of the drum or cage-strainer. The whole needs to be enclosed in a properly fitting case or container. One end of this container has a central hole with piping attached, while the other end has a removable plate or lid capable of being securely clamped and rendered water-tight by means of hinged or detachable wing-nuts. In the centre of this detachable lid is a hole through which issues the outlet tube of the strainer when placed in position. This joint must be provided with a rubber washer and made water-tight by a proper screw union. The hosing or pipe from the other end of the casing is coupled up

with a tap or other convenient exit in the lower part of a barrel or tank mounted on a wooden platform at a suitable height (Fig. 5).

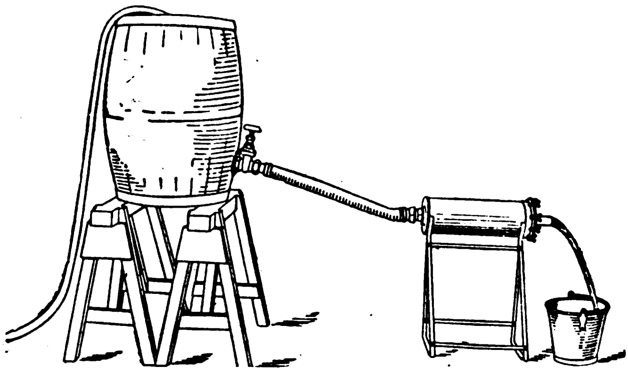

FIG. 5.—BARREL AND STRAINER CONNECTED UP.

If this receptacle be filled with water, this flows by gravity along the pipe to the interior of the metal container from which it can escape only by passing through the flannelette strainer and thence out by the central outlet tube. The delivery of clear water by this arrangement varies naturally with its degree of muddiness and what head or drop is given to the water running from the barrel or tank to the strainer. For general efficiency the head or pressure should not exceed four feet. Excellent results have been obtained by this method, and if the water in the tank be dosed with alum or hydrogel, the quality of the strained water is very high. Practically, 99 per cent. of contained bacteria can be removed from dirty water by this method. When using a muddy water the delivery falls off considerably, owing to the suspended matter becoming deposited on the flannelette which gets clogged. Using a strainer of this kind, measuring 20 inches in length and five inches in diameter, and with a fall or head of three feet, the output varies from 200 to 300 gallons an hour, according to the original degree of muddiness of the water. When clogged up, as shown by the lessened outflow, the flannelette only needs washing and boiling, or to be replaced by fresh layers. The intelligent application of this system of water clarification affords a valuable means of purifying water when other and more elaborate procedures are not possible. It is specially suitable for camps or fixed posts. In place of flannelette, felt, blanketing, canvas or other fabrics may be employed.

47. Filtration is really an exaggerated system of straining or clarifying, and aims at purifying water by catching or holding back the smallest particles of suspended matter, including germs, and allowing to pass whatever is in a state of solution or dissolved in the

water. Ordinary clarification fails to remove the germs or very small suspended particles. The difference between filtration and clarification is merely a question of the size of the apertures in the straining material. When the material is so dense and close in texture that the smallest suspended particles cannot pass through, it is called a filter; if so open and porous that only the coarser particles are held back, it is not a filter but merely a clarifier.

48. The material usually employed for the filtration of water is specially prepared baked clay or pottery ware made into the form of a tube or candle. These clay filter-candles can be used either singly or grouped together in any convenient number, but in all cases they are enclosed in a metal jacket. The water to be filtered is forced into this metal container or jacket, usually by means of an attached pump. If the metal jacket is water-tight, which it should be, the only possible way by which the water can get out is by passing through the more or less porous clay tube, from which it escapes by a suitably arranged outlet, tube, or pipe. This procedure causes the water in the metal jacket to be under considerable pressure, and the greater the obstruction offered by the filter-candle to the flow of water through its mass, the greater will be the pressure under which the water is forced through the filter. The average pressure developed in this attempt to force water through filters of this nature varies from 40 to 50 lb. on the square inch. The result of this forced passage of the water through the tube is that all suspended matter is left on the surface of the filter-candle, and, if this candle be sound and free from flaws or cracks, the water which passes through is quite sterile and free from germs.

It will be obvious that the success of this method of filtration depends absolutely upon the freedom of the filter-candle from flaws or cracks. The weakest point in all these candles is the line of junction between the clay and the metal ends. Mere inspection will not detect any but large cracks or fissures. For the routine examination of filter-candles, it suffices first carefully to damp the surface of the clay with a little water, then carefully to close the open end of the candle by pressing the finger over the aperture and then gently hold the candle at a depth of an inch under clean water taking care all the time to keep the open end closed by pressure of the finger. Air will be imprisoned inside the filter-candle as the result of closing its aperture, and its only possible means of escape will be through the porous clay or by a hole or crack. While immersed under water, any escaping air will be manifest as air-bubbles arising to the surface. If the candle is quite sound, the escaping air will be apparent only as minute air-bubbles issuing evenly from the whole surface of the candle. There will be no large bubbles. If there are large air-bubbles rising from any point, it indicates some flaw, crack or weak point. If this be observed, the candle must be rejected as unsound; if, on the other hand, the air issues evenly and only as very tiny bubbles then it may be presumed

to be good and sound. The examination can be conducted in a similar way by connecting the aperture with an ordinary bicycle pump by means of some rubber tubing, and then, after laying the candle under water, forcing gently some air into its interior cavity. It is not a fair or reliable test to force the air in vigorously ; a gentle pressure or working of the pump suffices.

The action of the filters being merely to hold back the suspended matter in water which is collected on their surface, it follows that a gradual clogging of their pores, with a corresponding lessened flow of water through them, results. When the output becomes diminished the filter-candle needs cleaning by brushing the surface under water. This process in course of time weakens the filter by removing some of its substance, but with care the life of an individual tube can be made to extend over a couple of years. A more serious risk attaching to the routine use of filters of this kind lies in the fact that in the course of time germs, if present in the water under filtration, are capable of working their way into the pores of the medium, and even through its mass, so as to appear in the filtered water. In their passage through the actual filter they are helped by the pressure under which the water is forced through. The result of this is that filter-candles, if used for the filtration of dirty water, frequently become a seriously infected mass, and a possible means of polluting an uninfected water passing through them, consequently these candles must, for safety's sake, be sterilized every fourth day by boiling them in water for one minute. This is the regular practice in the army and must be rigidly carried out.

49. Excellent as these clay or pottery ware filters are for removing germs and other minute suspended matter, their employment is often difficult when very muddy water has to be filtered, owing to the mud, fine sand, or clay collecting on the filter service and clogging up its pores so much that the water cannot get through. To avoid this and the consequent repeated brushings and cleanings, it is usual to submit the water to a preliminary clarification before it reaches the filter-candle.

50. Sterilization of Water by Chemicals.—Water can be sterilized and purified undoubtedly by means of chemicals, but as a practical method for cadets it presents many difficulties. The chief are :—The necessity of portability, simplicity in working, rapidity of action and that the treated water be free from taste or smell. A large number of chemicals have been suggested and tried for water purification, of these the most useful for soldiers in camp or in the field are alum, permanganate of potash and the acid sulphate of soda.

51. If *alum* be added to a muddy water in the proportion of a teaspoonful to a bucketful, and well stirred, a gelatinous cloud will form and slowly fall to the bottom, carrying with it most of the mud and other suspended matter, leaving a clear liquid which can then be drawn off. This action of alum will not sterilize the water but merely clear it ; it is, however, rather slow, taking an hour or more to act properly, but when time is no object and a muddy water has

to be cleared when no filters or strainers are available, alum is a useful stand-by. Alum does not act well with all waters, its best effect being obtained in waters which contain lime; rain and other soft waters do not readily clear by means of this chemical. It must not be forgotten that alum will not kill the germs; it removes a great number by throwing them to the bottom, but to make certain the cleared water should be boiled or strained afterwards. The use of alum in conjunction with straining and filtering has been previously mentioned. As a useful help for the more rapid clarification of water by improvized methods, alum or some mixture containing alum is a most valuable chemical.

52. *Permanganate of potash*, if added to water in sufficient quantity to make it pink, is another useful means of purifying water. It acts like alum in making a sediment and causing the water to clear gradually if allowed to stand; it also has a mild action on germs, killing them. This germ-killing power is, however, somewhat slow and feeble; for this reason, reliance cannot be placed on permanganate to purify very foul waters. The germ which is most readily killed by this chemical is the microbe which causes cholera. For cleaning out barrels, tanks, cisterns and other receptables for storing water, the addition of the permanganate is extremely useful. Sufficient should be added to make the water a good rose-pink colour. The water should then be well stirred and allowed to stand for quite three hours. Permanganate gives no taste to the water, and is quite harmless to anyone drinking the pinked water.

53. The *acid sulphate of soda* is practically so much sulphuric acid in solid form. It is supplied conveniently in tablets, sweetened with saxine and flavoured with oil of lemon; if one of these be dissolved in $1\frac{3}{4}$ pints of water or the contents of a water-bottle, it yields enough acid to that water to kill any disease-producing germs, which may be in that water, in twenty minutes to half an hour. The water will taste faintly acid and not unlike an inferior or flat lemonade; this acid water is quite harmless and fit to drink. By the issue of these tablets to cadets, it is hoped that each cadet will be able to keep his water-bottle sweet and clean and free from germs. Thus, say a cadet fills his bottle full of water overnight, drops in one of the acid tablets and allows it to dissolve and remain in that water till the morning, the contents of the bottle will be quite free from disease-producing germs. He can either use that same water for drinking purposes, or he can pour it away and refill the bottle with filtered or boiled water. By so doing, he will be certain, however, that his bottle is clean and free from germs. A more preferable way is not to allow the acid tablet to remain such a long time as ten or twelve hours in the bottle full of water, but to add it to the water only about an hour before he is likely to want to drink some of the water. It must be remembered that the adding of these acids to a muddy water will not clear that water—that must be done by straining; the acid tablet will only kill germs in water, not remove mud, and the germs are not killed until after at least twenty minutes. Used in this way these tablets should be of great value to cadets and others who are

unable to get their water properly filtered, boiled or otherwise sterilized by heat. The proper use of these tablets, if issued, is entirely a matter for the cadet himself; he must understand what he is doing and why he is doing it.

54. *Chlorine*, derived from the electrical decomposition of a salt solution, presents some promise as a means of purifying water in bulk, but, as in the case of using *ozone* for a similar purpose, the procedure has not reached a practical form. If chlorine is used at all, for soldiers, it is best applied to water in the form of pellets or tablets of bleaching powder. Some success has attended this method, but the chief objection is that the water acquires an unpleasant taste. True, this unpleasantness can be removed by adding another tablet containing hyposulphite of soda, but this introduces the complication of having two chemicals instead of one. For this reason, the method is unsuitable for cadets. The same objection applies to the use of *iodine* or *bromine* for the purification of water. Both these chemicals rapidly purify water, killing germs within five minutes, but the water is undrinkable until the iodine or bromide is removed by the hyposulphite of soda.

55. The utilization of chemicals for purifying water in camps and in the field is very promising theoretically, but its practical application in military life is full of difficulties. It is not implied by this that the matter is to be dismissed from further consideration; on the contrary, every endeavour should be made to develop the idea, but until a chemical can be obtained at once more simple and efficient than any as yet suggested, it must be admitted that the use of chemical methods by individual cadets offers but a slender prospect of being generally applied with success. It can be carried out successfully only for large quantities of water, say 100 gallons at a time. Used in this way for the contents of an ordinary water-cart, the iodine method is quite practicable. It is done in the following way:—Three sets of tablets are made up and packed together in a small box. One set of tablets is red, another is white and the third is blue. The tablets are made up in sets of ten or a sufficiency for 100 gallons of water. The red and white tablets are broken up and dissolved in a little water in a metal cup; the water turns brown and smells strongly of iodine. This is now emptied into and well mixed with 100 gallons of water, say the contents of a water-cart. If allowed to act for ten minutes, the iodine kills all germs in the water. At the end of the ten minutes, but not before, in order to remove the iodine and so make it fit to drink, the blue tablets are added to a little water, broken up and then well stirred in the 100 gallons which have been treated with iodine. After a few minutes, the iodine will have been removed and the water found to be sterile, free from smell or taste and quite fit to drink. The only care needed is to use the red and white tablets together, allowing them to act for ten minutes; the blue tablets must not be added to the water until after the ten minutes.

CHAPTER VI.

THE FOOD OF THE CADET.

56. A food has been defined as "anything which, when taken into the body, is capable either of repairing its waste or of furnishing it with material from which to produce heat or nervous and muscular work." In other words, food has two main functions, *i.e.*, (1) to provide for the growth and repair of the tissues of the body and (2) to act as a source of energy which can be converted into heat and work. Most articles of diet are made up of mixtures of various chemical substances, the nutritive constituents of which may be classified into :—(1) those that contain nitrogen, (2) those that do not contain nitrogen, (3) salts, (4) water. The nitrogen-containing food or proteins are present in the flesh of various animals, also in eggs, cheese, the curd of milk and in a few vegetables like peas, beans and lentils. The non-nitrogenous foods consist of (1) carbohydrates such as sugar and starch and (2) fats, animal or vegetable. The function of building up and repairing the tissues can be fulfilled by the nitrogenous foods, and by these alone.

The function of supplying energy is the property of both the nitrogenous and non-nitrogenous foods.

57. It is thus apparent that the nitrogenous foods alone are able to fulfil both the functions of a food; without them life is impossible. With nitrogenous food, water and salts, the body may be maintained in a healthy condition for a considerable time; but for the best forms of diet, both fat and sugar or starch, are required in addition to nitrogenous foods.

58. Salts, especially common salt, are essential to health; the various salts of the body, such as those of calcium, iron, sodium, potassium and phosphorus are all derived from the nitrogenous and non-nitrogenous foods.

59. Water serves for the solution and conveyance of food to the various parts of the body, and also for the excretion of useless products. It is not received into the body solely as a liquid, but forms a large proportion of the solids taken. Meat contains 72 per cent., and bread 38 per cent. of water.

60. Such being the uses of foods in the body, how is their relative value to be judged? Chemical analyses will show how much of the nutritive substances a hundred parts of the food contain. In this way, an idea is obtained of the value of the food as a source of tissue building material and energy. At the present time, however, it is usual to estimate the energy value of a food by means of the amount of heat produced when it is completely burnt or oxidized. There is a definite relation between heat produced and work done.

61. The standard employed is the amount of heat which is required to raise 1 lb. of water 4° F. (or 1 kilogramme of water

1° C.). This amount of heat is called a Calorie (written with a capital letter). To apply this test, it is only necessary to ascertain how many pounds of water will be raised 4° F. (or kilogrammes of water 1° C.) in temperature, by completely burning 15·5 grains (or 1 gramme) of the food. The result gives the value of this amount of food in terms of Calories. Tested in this way it has been found that the complete combustion of 15·5 grains of fat ribs of fresh beef yield 3·6 Calories. Though the Calorie test is useful for comparing the value of foods, it must not be supposed that the food will necessarily give the amount of energy when taken into the body. In order that the energy may be obtained the food must be properly digested and more or less completely absorbed into the blood.

62. The quantity of food which a cadet should receive depends mainly on the amount of work which he is obliged to do. Food is required to furnish energy for the internal work of the body, *i.e.*, the heart's work, &c., and to maintain the body temperature. This amount must be supplied whether at work or at rest in order to maintain life. But if a cadet does external work, such as marching, fighting or any labouring work, he must have more food to supply energy for the work done. With regard to the external work and the amount of power required to be supplied by food to produce that work, it is estimated that in ordinary circumstances a cadet transforms about one-sixth of the total available energy of his food into work, the rest being lost in the form of heat. This loss is inevitable, but it compares favourably with that experienced in a steam engine, where the work done is about one-eighth of the total energy supplied by the fuel consumed. If a cadet were simply doing the usual parades and fatigues, the work would correspond to between 500 and 600 Calories and his food should then contain not less than from 3,000 to 3,500 Calories. If the muscular work be increased as on manœuvres and on active service, then there must be a corresponding increase in the amount of food consumed. On manœuvres at least 4,000 Calories should be supplied, and during active service a diet containing from 4,500 to 5,000 Calories should be given. Though work is the most important condition which influences the amount of food required, build, weight, age and climate have also to be taken into consideration.

63. Build is more important than weight; the larger the surface of the body in relation to its bulk, the greater is the loss of heat by radiation, and the greater the amount of food required to maintain the body temperature. A thin cadet requires more food than a fat cadet of the same cubic content, because the former has a greater amount of surface exposed. A child, relatively to its weight, requires more food, because it has a large surface in proportion to its bulk. A cadet whose weight is due mainly to muscle will require relatively more food, especially nitrogenous food, than one who owes his weight to bone or fat. Young cadets also require more food than those of maturer age.

64. As regards climate, the temperature of the body is mainly adjusted by regulating the amount of heat lost. As the external temperature rises, the body requires less heat, and the balance is usually adjusted, not by eating less food, but by increasing the loss of heat through wearing thinner clothes. When the external temperature falls, the loss of heat is diminished by wearing thicker clothes. In very cold climates, the demand for heat is so great that a greater consumption of food, particularly fatty food, is necessary. In very hot climates, on the other hand, the demand for heat is much less, and a man instinctively avoids the nitrogen-containing foods and the fats, from which a large quantity of heat is produced in a short time, and resorts to vegetable foodstuffs.

65. Admitting that with an increased amount of work there should be a corresponding increase in the amount of food, arrangements must be made to increase all the nutritive constituents, proteins, fats and carbohydrates. A mixed diet is essential ; no one article of food contains the different nutritive constituents in proper proportion, and the excess of a particular constituent in one article must be played off against its deficiency in another. Experience has shown this to be necessary, hence the usual combinations of bread and cheese, potatoes and beef, in which the excess of the carbohydrates in the bread and the potatoes is balanced by the proteins and fat in the cheese and beef. Variety is of paramount importance. An unvaried diet may be not only extremely distasteful, but may have serious consequences as regards general health and liability to disease. The causes of this are not quite clear, but there is no reason to doubt that the varying appetite for different kinds of food is an expression of the bodily requirements of which a strict scientific account cannot be given. Also the constituents of a mixed diet are better absorbed than any one article of food when taken by itself.

CHAPTER VII.

THE HYGIENE OF THE MARCH.

66. This is a matter which deserves earnest consideration, as apparently trivial mistakes made under these circumstances have often far-reaching effects. Further, these mistakes have reference mainly to a variety of details which are intimately concerned with the acts of the individual ; in other words, their remedy lies not so much in the issuing of orders as in the inculcation of knowledge and sense of responsibility in the mind of the cadet himself.

67. Preparation for the March.—In preparing for a series of marches, it is important that all cases of disability should be segregated and left behind. Great care, therefore, must be taken

that only fit cadets are permitted to join the columns. The next essential preliminary to every march is to see that the cadets do not start on empty stomachs. This does not mean the issue of a large meal, but rather the consumption of light refreshment, such as tea or coffee with bread or biscuit; this is particularly desirable when the cadets break camp and move off in the early dawn, as at such times a little food and a warm drink does much to lessen fatigue and increase resistance to disease.

68. Time, Length and Speed of the March.—The hour of starting and the length of the march are matters upon which any precise rules are impossible, since any movement of troops is influenced by weather, roads and military necessity. The custom is to march in the early morning; the cadets are fresh, the air is cool and the main effort can be completed before the heat of the day comes on. Night marches are to be deprecated; except under the stress of military necessity, the loss of sleep and general discomfort occasioned by night marches may be considered far to outweigh the ordinary advantages to be gained thereby.

As to the length of the march, a fair day's effort for infantry under usual conditions may be said to be from 8 to 12 miles. Of course much more than this can be done, but a greater average than 12 miles daily is rarely achieved, except by small bodies of cadets and for short periods. The severity of a march is not to be measured so much by its mere length in miles, but rather by other factors, such as pace or time in which done, load carried and formation or position in the column.

The rate of speed and individual ease with which a march can be done depends largely on the size of the command. An infantry battalion will cover a 12-mile march in something under six hours, but an infantry brigade will need nearer seven hours for the same distance, and a division will require eight or nine hours. The question of individual ease when on the march is complicated by the fact that the movements of the cadet are to a certain degree unnatural or constrained. As far as possible the movements of the individual cadet should not be impeded by restrictions of an unnecessary nature, and every endeavour made to turn what is a compulsory military movement into a salutary and stimulant exercise. Thus in hot weather, cadets should be made to unbutton their coats, turn them well back and present as few obstacles to free expansion of the chest and personal comfort as possible. The question of formation and position in the column are details of great moment to the individual. On dusty roads, close order becomes particularly trying to the foot soldier, and for this reason it is a good rule that, if the military situation permits, infantry on the march should preserve a wide front and as open a formation as possible, in order to avoid the effects of crowding. Without ventilation through the ranks the air soon becomes very foul.

69. Mental Occupation.—Few things harass troops on the line of march more than straggling. It is an evil which needs to be firmly controlled. Its prevention depends upon a careful elimina-

tion of the sick, the encouragement and assistance of the tired, and the application of suitable measures to the undisciplined and lazy. To occupy the minds of the cadets on the march is probably the surest way of preventing fatigue; to this end a band or singing does much to lessen the tedium of a journey.

70. Foot-soreness.—The proper care of the feet, while rightly within the purview of all officers, is mainly a matter for the individual cadet. Ill-fitting boots and socks, combined with uncleanliness of the feet, are the real causes of this disablement of the marching cadet. The ablution of the feet at least once daily should be compulsory. Excessive sweating of the feet may be relieved by bathing in a solution made by diluting one ounce of formalin with two pints of water. For the same purpose, soaking the feet in water coloured red with permanganate of potash is useful, so also a 2 per cent. ointment of salicylic acid made up with tallow or vaseline is recommended, or a powder made up of salicylic acid 3 parts, starch 10 parts, and powdered talc 87 parts. These remedies are at best but palliatives; the real remedy lies in the provision of a well-fitting boot and a soft, smooth sock to cover the foot. Much of the cadet's difficulty turns on the fact that his sock tends to shrink quickly and so causes creases. To reduce this trouble, cadets should be taught to stretch their socks when they take them off, also at the end of a march to shake out and stretch the sock, then putting the sock which has been worn on the right foot on to the left and vice versa. The inside of the sock, too, should be greased with soap where it fits over tender parts of the feet. In cases where the sock is much shrunken and obviously ill-fitting, and where no spare pair is available, it is better for the cadet not to wear socks at all, but simply cover the foot over with ordinary newspaper. If the foot be placed in the centre of a page of any newspaper, the paper can be quickly wrapped round and so moulded to the shape of the foot as to make an excellent substitute for a sock. This covering will protect the foot for a day and be readily replaced by more paper. When blisters or chafes arise, they must be appropriately treated; the blisters must be pricked with a clean needle, and all tender parts covered with soap or some simple and clean grease.

71. Water Discipline.—A common fault, even among experienced soldiers, is a too free recourse to the contents of their water bottles, and the tendency to drink each time they approach usable water. While arbitrary control over the use of the water-bottle on the march is as unwise as it is impracticable, still it is well to explain to the cadets the advantages of husbanding their resources and of developing a proper sense of water self-discipline. Much can be done to prevent the sensation of thirst by carrying a pebble in the mouth to excite the flow of saliva. To the same end, breathing through the nose rather than through the mouth should be encouraged. The water-bottle should invariably be filled with approved water before starting on the march, or it may be filled with unsweetened tea or coffee; never with beer or spirits. At all

halts near water the quality should be determined by the medical officer, and on his verdict or advice should depend whether the cadets' bottles are refilled or not at that source. The various modes suggested for purifying water have been discussed. Mention may, however, be made here of the paramount importance of all officers exercising a supervision as to the general cleanliness of the cadets' water-bottles and the regimental water-tanks. The successful carrying out of this detail is merely a matter of initiative and a little trouble. Washing out with boiling or very hot water is the most rational method of cleansing the bottles. The practice of attempting to scour out the inside of a bottle by placing stones, sand, or gravel in it and then shaking, followed by washing out with water, should be discouraged. The sand or stones are usually dirty, and the last state of the water-bottle will be worse than the first. In circumstances where there is an ample supply of clean water the ordinary washing out with three or four fillings with this safe water is a reliable procedure, but to be of any use this and all similar methods must be carried out under the supervision of an officer. Water should never be kept in the bottles when the water-bottle is not in daily use.

72. The Halt.—Periodical halts must be made during all marches. These are generally for five minutes in each hour, while on long marches a halt for half an hour is made usually half-way. Some care needs to be exercised to prevent cadets getting chilled on these occasions; shade should be taken advantage of in hot weather, but when the cadets have been perspiring freely, it is open to risk if any breeze be blowing. The most important sanitary question connected with all halts is the need of sanitary police to control and prevent the reckless fouling of the vicinity of the halting places by men who retire to ease themselves. Too much stress cannot be laid on this point; the essential need is for the officer in command to allocate at once areas to which the men may resort, and to place piquets or sanitary police over these places to see that the cadets, using the same, cover up all excretal matter deposited there. The covering of this material with earth need be no elaborate effort, nor involve more than the preliminary scratching of a shallow hole with the point of the boot, sword, bayonet, or a stick, and the depositing of the excreta in this shallow depression, taking care on completion of the act to cover the ordure over with the displaced earth. Failure to comply with this practice should be made the subject of disciplinary measures.

73. A more preferable routine is for the sanitary duty cadets to proceed with their companies or units, each carrying a pick and spade. As soon as the halting place is reached, these cadets should proceed at once to the easement areas and prepare urine pits or trenches and shallow latrine trenches. These sanitary detachment men should remain and see that those resorting to these trenches use them properly. Immediately the "fall in" sounds, they should fill in the trenches and pits, replace turf, and leave the spot clean, tidy, and wholesome. There can be no doubt that the strictest discipline

is needed at all halting places, if only to check or prevent the wholesale fouling of wayside areas where marching columns halt. The remedy is comparatively simple, involves little personal effort, and is limited to the exercise of a small amount of administrative capacity and an attention to details as explained. This question is entirely one of discipline; its fulfilment can only follow the awakening of a sense of sanitary responsibility in the officer, coupled with intelligent obedience and co-operation on the part of the cadets.

74. On halting for the day, or arriving in camp, one of the first duties of the officer in command of the unit or party is to send out piquets to protect and safeguard the water supply from indiscriminate use and consequent probable pollution: this detail will embrace the allocation, when possible, of separate sources of supply for cadets and animals. Concurrent with this primary duty, will be the sending forward of the sanitary duty cadets to prepare latrines, urine pits, and other places for easement of cadets when they arrive in camp. These may be of a temporary nature only, but some must be provided without delay, if only to preclude casual easement and consequent rapid fouling of what otherwise must be maintained as a clean and wholesome area.

75. The duties of the sanitary duty cadets in this connection may be detailed as follows:—(1) Make a sufficiency of latrines for one day for (*a*) officers, (*b*) non-commissioned officers and (*c*) cadets. (2) Make a urinal for (*a*) officers, (*b*) non-commissioned officers and (*c*) cadets. (3) Dig a urine-pit to receive the contents of the night urine tubs if they are used, or dig a series of urine pits at end of lines for night use. (4) Make the necessary drains and pits for the disposal of waste water. (5) Make straining pits or traps for greasy water, namely, one for each cooking place, one for serjeants' mess and one for officers' mess. (6) Build such incinerators or refuse pits as may be needed. (7) Prepare drains for carrying off excess water from stand-pipes and around ablution or washing places.

76. As for the cadets who compose the main party, after settling down in camp or bivouac and getting food, every cadet should examine his feet. Blisters should be pricked, the feet cleaned and the socks shaken out. After the feet have been attended to, the body should be washed, or as much of it as is possible in the circumstances.

CHAPTER VIII.

SANITATION OF CAMPS.

77. The same principles and ideas which animate efforts to prevent disease in barracks must be applied to camps, and with doubled energy. The need of this will be at once apparent if it is remembered that the moment cadets go into camp or bivouac they revert to a simpler mode of life, and find themselves removed from all the more or less elaborate appliances of barracks.

78. Camp Sites.—The selection of a camp site is dominated by the facilities which exist for obtaining water, this is particularly so in regard to temporary camps; but where camps are likely to be occupied any length of time the feasibility of bringing the water to the camp must be as much considered as taking the camp to the water. The proper location of a camp, as a matter having a definite influence on the health and efficiency of cadets, demands intelligent consideration. It is a good rule to select a site as if for continued occupancy, since the mere bivouac may, through necessity, become a camp of a more or less permanent character.

When possible, camps should be placed on high ground, since not only is the surface drainage better, but exposure to air currents facilitates evaporation. Situations at the base of hills are usually damp, such a site may be acceptable if a transverse ravine intercepts the drainage from the higher ground. No camp should be placed in ravines or the dry beds of watercourses. Low plains surrounded by high land, valleys, and hollows are often hot and damp. The vicinity of marshes or irrigated lands, as well as areas periodically under water, are always unhealthy and favourable to mosquitoes. Similarly, situations at the mouths of rivers or places to which surface or subsoil water gravitates are always undesirable, for obvious reasons. An abandoned camp site should never be utilized, except in circumstances of great necessity. Old camping grounds must be considered as more or less permeated with the organic soakage incidental to human occupation. As regards actual soil, it may be said the more porous the better, but if a camp must be pitched upon an impermeable soil, like clay or rock, the locality affording the best surface drainage should be chosen. Ploughed land should be avoided, so, too, should very dusty areas; in all cases grass covered soil is preferable. In the selection of camp sites apart from the question of water supply, the golden rule to follow is:—Choose areas which are not only dry but clean, that is, have not been occupied recently for encampments, and are not fouled or in any way encumbered with the recent filth of man and animals.

79. All tent-walls should be looped up during fine weather, so that the tent area may be dried and disinfected by fresh air and sunlight. Even in cold and doubtful weather, the sides of the tents should be tied up during the absence of the occupants. If removal to a new camp site or fresh tent area be not practicable, all tents

should be struck and their enclosed ground area sunned or aired for a few hours every four days, In a properly arranged camp, the intervals should be always sufficient to render the shifting of a tent to a new site possible. Where huts are used, the doors and windows must be open to permit of aeration and the entrance of sunlight, and the roof, if of canvas, should be turned back. The digging up or excavation of the soil within a tent area should be discouraged, as tending to impede ventilation and due cleanliness ; if floorboards are not available, then the ground may be covered with either straw or a tarpaulin, but whatever is employed it must be turned out and well-aired and cleaned daily, so long as weather permits. Blankets and bedding must be sunned and aired each day, either by hanging on supports erected especially for the purpose, or by spreading on the sunny side of the tent roof ; the former plan is preferable, as it allows access of light and air to both sides of the article.

80. Another important practice is to discourage the cadets, as far as possible, from eating their food in the tents, and also to forbid storage or retention of food in them. Food material attracts flies, is very difficult to keep sweet or clean, and in warm climates rapidly deteriorates. All remains of food, particularly if not likely to be utilized in a few hours, should be either burnt or buried.

81. Official regulations do not refer to it, but an important point to be borne in mind when planning or laying out camp areas is the need to allow a sufficiency of ground for what may be termed the conservancy area, as distinguished from the inhabited area. No hard and fast rules can be laid down, but for general guidance it may be said that a depth of 20 yards should be allowed to intervene between the canteens, cook-houses and washing places and the latrines, urinals and incinerators. On a subsequent page a diagram is submitted as a type of how a suitably arranged encampment may be planned in regard to these details.

82. Water Supply.—The general principles affecting this question have been considered and need no detailed discussion in this place, except it be to emphasize the fact that it is the duty of the commanding officer on forming or occupying a camp or bivouac, to secure and protect the water supply. The question of the quality of the water available will be determined by the medical officer, and in accordance with his advice action must be taken as to treatment and general distribution. The protection of the supply from pollution permits of no delay; action must be prompt and thorough, involving the placing of piquets to warn off unauthorized access, and where only one source of supply is available, to prevent pollution by animals drinking before the cadets' supply has been drawn. Where the circumstances permit, water for animals should be taken at a point distinct from that supplying cadets: in the case of running water the animals' drinking place must be below that whence the water for troops is taken.

In camps, water is carried usually from its source to the lines in water-tanks on wheels; but other vessels, such as pails, canvas

troughs, barrels, chatties and skins are used. In all cases the very greatest care is required to keep these receptacles clean. This is by no means easy to do, and whether it is done must depend largely on circumstances. There is no simple procedure, and the only all-round method is the washing or flushing out with ordinary water made a deep red colour by means of permanganate of potash, repeating the process so long as the water fails to remain of a pink colour after three hours. This will not sterilize these receptacles, but it will destroy the greater number of contained bacteria and render the vessels reasonably safe and clean. If water is kept stored in camp, the vessels must be protected by suitable covers. Cadets should not be allowed to drink direct from the taps of water-tanks or from the rim or spouts of other receptacles used for carrying or distributing water.

83. Kitchens and Ablution Places.—These are a fruitful source of untidiness in camps, and consequently need to be managed and so arranged that remains of food and all greasy water is rapidly and efficiently removed from the immediate vicinity. The most important details which need attention are :—(1) That the kitchens and washing places be located so as to be handy for water, but remote from latrines, urine-pits or other receptacles for refuse and garbage ; (2) all greasy water must be made to pass readily away : this will usually be effected by a passage into soakage-pits, and, if this does not suffice, then by drainage away along suitably-dug trenches. This waste-water is greasy, and if allowed to pass direct on to soil soon makes a felt-like scum, which not only impedes the soaking-in of the water, but also attracts flies. A useful plan is to fill the reception pits or the upper ends of the drainage channels with coarse brushwood ; if the greasy water be poured on to this mass of brushwood, the grease and other organic solids are entangled,

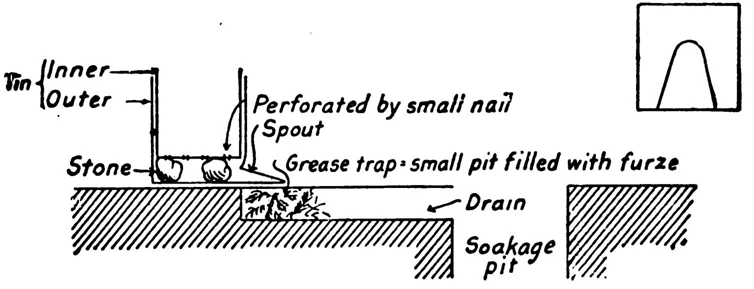

FIG. 6.—GREASE TRAP FOR CAMPS.

allowing the clearer liquid to run freely away. The brushwood, loaded with fatty matter, is conveniently burnt daily and replaced by fresh cuttings.

An alternative plan, which has been found to be effective and easily improvized, is the following :—Take two large biscuit tins, the upper acting as a coarse strainer, and the lower serving to direct the water over and into a small pit, which, filled with grass, heather, or brushwood, acts as a grease trap. From this small pit cut a shallow trench leading to a large soakage-pit (Fig. 6). The inner tin should rest on two or more stones, so as to allow an interspace. The lower tin can be given a spout, conveniently made by cutting an inverted U or V-shaped flap from one of the sides, turning down and rounding off. Modifications of the foregoing can be made by turning a box upside down over the pit or grease trap, the bottom of the box being perforated with a hole into which is fitted a

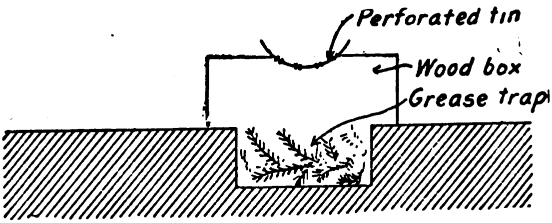

Fig. 7.—Grease Trap for Camps.

colander or piece of perforated tin (Fig. 7). An even simpler arrangement is that shown in Fig. 8, which consists merely of a grease trap filled with bracken or gorse, a drain from it and a final soakage-pit, the earth at the bottom of which has been loosened by a pick. In all cases the furze, grass, or brushwood used to entangle or trap the grease must be burnt and renewed daily.

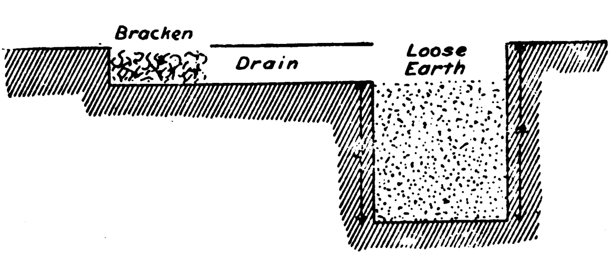

Fig. 8.—Grease Trap for Camps.

84. In connection with the kitchens and food supplies in camp it is desirable that the arrangements for washing cooking utensils

receive attention. At each kitchen or mess there should be an appointed place devoted solely to the cleaning up of utensils. This should have a table, or boxes to serve as a table, a suitable straining pit handy, a sufficiency of clean cloths and a plentiful supply of hot water. If sand is used for cleaning vessels, this should be previously baked over a fire, collected and kept in a tin or box near the cleaning bench. Ashes from the wood fire may be used in place of sand. The whole process of washing up, collecting and baking of sand should be under the supervision of one of the cadets of the sanitary detachment or sanitary squad.

85. The ablution places need to be located conveniently near the cadets' tents, and the soiled or soapy water therefrom drained away on similar principles to those indicated for kitchen sullage-water Where ordinary ablution-benches with foot-gratings are available, care needs to be taken to prevent the adjacent ground becoming sloppy. Whether benches are available or not, the water must be run away quickly and tidily; the arrangement shown in Fig. 9,

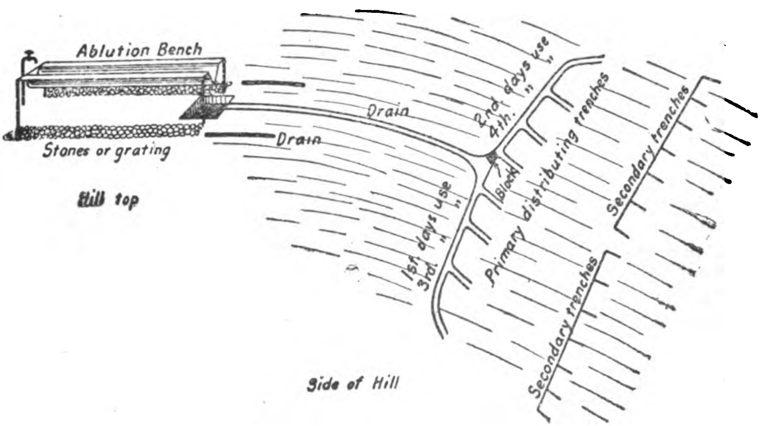

FIG. 9.—ABLUTION PLACE AND DRAINAGE IN CAMP.

modified according to the fall of the ground, will be found to meet the requirements of most cases. This work should be carried out by the sanitary detachment or sanitary squad.

86. In semi permanent camps, some trouble should be taken to give the cadets reasonable facilities for baths. A very little initiative and ingenuity should suffice. Thus, a large tent or marquee can be divided by canvas screens, each compartment containing a seat, a foot-grating, and a tub or tin bath. The bath can be fitted with a wooden plug, which is made to discharge over a trough of

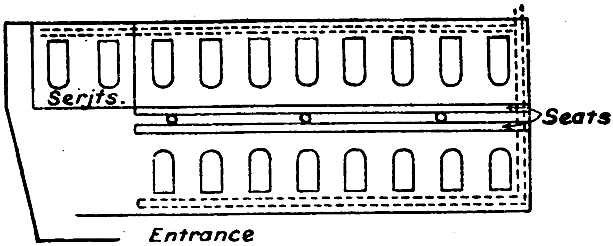

FIG. 10.—WASHING PLACE IN CAMP.

galvanized iron (Fig. 10). Or, a temporary hut can be made of canvas stretched over rough wood supports. A long seat should be arranged down each side, with a suitable number of foot-gratings and metal baths; these latter can be emptied by tipping

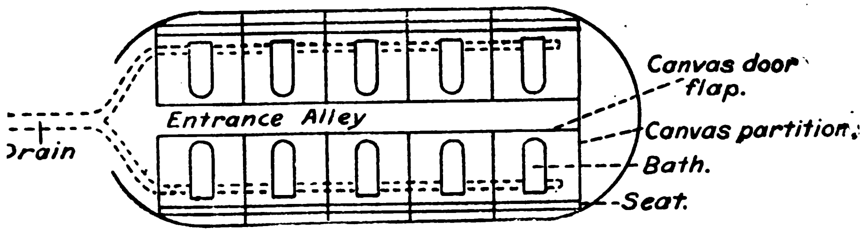

FIG. 11.—WASHING PLACE IN CAMP.

into a conveniently cut drain (Fig. 11). Even an ordinary bell tent can be used, placing in it six iron tubs which can be emptied into a soakage-pit, from which leads a drain to a larger pit outside. Unless some devices of this kind are resorted to and more facilities afforded to the cadet in these fixed camps for obtaining a decent bath with some measure of privacy, it is futile to expect a high standard of personal cleanliness from him.

87. In standing camps, unless the physical condition of the soil and the gradients are distinctly favourable for a rapid absorption and soakage away of all sullage and ablution water, it will be advisable either to shift the location of the kitchens and washing places every few days or to collect this liquid in watertight receptacles. Such receptacles should be placed on raised platforms for the better protection of themselves and the ground beneath them, and should be emptied daily and the contents disposed of outside the camp area. Before being returned to use, they should be cleaned and smeared over with a cloth soaked in crude creosote oil.

88. Drying of Clothes.—Closely associated with the personal hygiene and comfort of the cadet, both in camps and in bivouacs, is the question of drying clothing which has been wetted by rain. It is true the wearing of wet clothes conduces to much less ill-health than many suppose ; still, a great deal of personal discomfort could be avoided if some simple means of drying clothes, at times when neither the sun nor wind can be utilized, could be devized. The following method is deserving of note :—Pitch as large a tent as is available, dig one or more holes, some two feet deep, within the tent, sufficiently far from the poles and canvas to minimize the risk of fire. Line the holes with stones, and carry the stones up so as to make a rim or parapet round the hole, some feet high. The stones must be fairly large, and the diameter of the hole quite three feet. If a fire be lighted in the hole and carefully tended, the stones soon get quite hot and radiate a good heat. The wet clothing should be hung round the hole as well as the appliances on the spot will allow, and the tent shut up. With a little care and initiative considerable numbers of wet garments can be dried in this way in a few hours. In place of a tent a rough shelter can be built, or use made of some outhouse on a farm. An alternative procedure is to rig up a simple

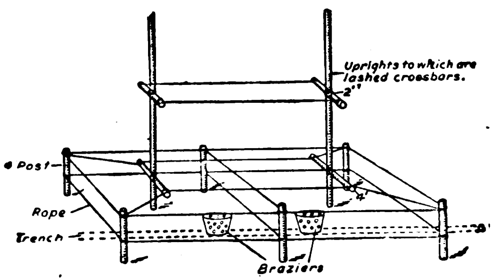

FIG. 12.—FRAME FOR DRYING CLOTHES IN CAMP.

framework, as shown in Fig. 12, by means of ropes, cords or wire. This should be erected either within a large tent or under some rough shelter, and one or more braziers improvized, from buckets or tins, full of wood ashes, placed at suitable intervals near to the wet clothing. These suggested methods are crude, but better than doing nothing to obviate the discomforts resulting from wet garments.

89. Disposal of Refuse.—The refuse of a camp consists of general rubbish strewn about tents, kitchen-garbage, bits of crockery, tins, paper and rags. This material must never be thrown casually on the ground, but needs to be dealt with strictly on a definite system.

It must be thrown invariably into special receptacles conveniently placed for the purpose. In camps which are of a temporary nature these receptacles best take the form of pits or holes, but where these are employed the contents must be covered over with at least six inches of earth three or four times a day, the constant endeavour being to protect the material from flies. Pits of this nature should be located near kitchens and one at the end of each line of tents, suitably marked with a notice, "rubbish to be thrown here." In more permanent camps, all this garbage and refuse should be placed in closed metal receptacles, the contents of which are removed and disposed of daily, as explained for sullage-water. In the absence of metal receptacles, the general refuse may be collected in sacks which are hung on posts placed at the end of the lines of tents. Kitchen-garbage can be collected in tubs, barrels or boxes, which need to be raised on stands close to the cooking places; these stands may be made by four short posts supporting a rough wood framework. On no account, unless necessity compels, should the solid and liquid refuse be mixed. Carts or other vehicles used for the removal of this material to the place of disposal should be designed so as to prevent any escape of their contents. The casual and too frequent mode of disposal of this waste material from camps to civilians, who collect and cart it through lines and encampments without regard to elementary sanitary rules, should be strenuously opposed. If removal is arranged for by civil contract, close supervision must be exercised to see that there is a sufficiency of suitable tubs or receptacles with covers, that the removal is made daily in proper carts, and carried out at definite times during daylight, when the movements of these scavengers can be followed. The supervision and management of all refuse receptacles is a part of the duties of the sanitary detachment or sanitary squad.

90. (i) The final disposal of kitchen-garbage and camp-refuse is a matter of great difficulty, particularly on field service; even in standing camps it is far from easy. The location of the place should always be outside the inhabited area, and placed to leeward of prevailing winds and remote from the source of water supply. There are two possible methods, burial and burning. The former is suitable for cases where the amount of material to be disposed of is not excessive, but when much refuse is present the labour necessary to dig sufficiently large pits is almost prohibitive. In these cases, as much as possible should be destroyed by fire, and what is not so burnt, must be buried; in fact, it may be said that burning is the ideal mode of disposal in all cases. Theoretically this is so, but practically it is difficult to carry out, mainly on account of the natural dampness of the material. In wet weather the difficulties from this cause are much increased. In the field, the methods for the cremation of refuse vary from the use of the company kitchen fire to the employment of specially constructed incinerators. Various portable destructors have been proposed and used in camps; for the general requirements of field service,

none can be said to be satisfactory. Failing any special apparatus being available for the burning of camp-garbage and refuse, ingenuity and common sense must be used as to the best method of effecting their combustion without offence.

(ii) Where crude mineral oil is available, its incorporation with the more combustible material constitutes an effective aid for the destruction of garbage by fire. In other cases, where iron rods or lengths of railway rails can be obtained, the construction of a simple grate or grid by placing these iron rods or rails on lateral supports made of turf or earth is eminently successful in maintaining a brisk fire, when fed with camp refuse. In any devices of this kind the great essential is to secure a draught of air under and through the material to be burnt; and the damper the mass the greater the need of air. Once a draught is secured, the fire will burn, provided, of course, common sense is exercised in not being in too great a hurry and not feeding the fire too quickly with cold, damp refuse. The failure to appreciate the necessity of slow feeding or stoking is the great fault of all attempts to burn camp refuse in field incinerators. These have to be made by the men of the sanitary detachment or sanitary squad, and they must be taught and practised in their construction and use.

(iii) An improvized refuse-destructor of a simple nature can be made by digging two shallow trenches intersecting each other at right angles; each trench should be 9 inches deep and 9 inches wide where they cross, and getting shallower to their ends. The length of each trench need not exceed 5 feet and may be advantageously made with an expanded or a trumpet-shaped mouth or end. Over the angles of intersection a chimney or shaft, some 3 feet high and 3 feet in diameter must be built up of turf-sods or bricks. Some ingenuity is needed to support the walls of the shaft or chimney where they cross the trenches. This can usually be overcome by utilizing bits of iron bands off bales or barrels, or even by knocking the bottom out of food tins and placing these metal

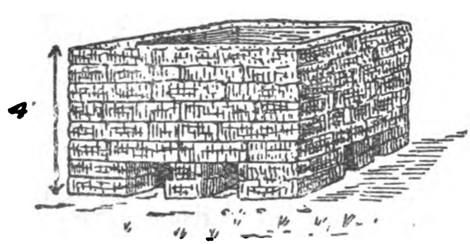

Fig. 13.—Camp Incinerator—Rectangular.

tubes in the trenches, so as to support the walls of the shaft. A fire can be quickly lighted with any dry material at the bottom of the shaft, and fed steadily by throwing rubbish and refuse down the top. Modifications of this type of incinerator are shown in Figs. 13, 14 and 15; these can be built quite easily of turf-sods or bricks.

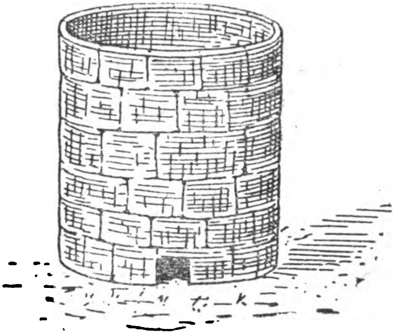

FIG. 14.—CAMP INCINERATOR—ROUND.

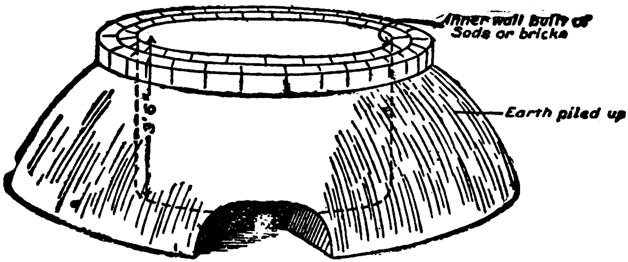

FIG. 15.—CAMP INCINERATOR—BEEHIVE.

The essential detail is to provide sufficient air inlets at the base. Disused meat-tins, with the tops and bottoms removed, make excellent frames for these openings. The air-inlets need to be raked out periodically and kept open and free from ashes. An alternative type of incinerator is a horseshoe-shaped mound of earth or sods, so arranged as to place the mouth to the windward side. The refuse is burnt within the ramped area, the sides of the ramp need not be more than 3 feet high. This design is particularly suitable when the soil is peaty or loose and crumbly. The dimensions of the rectangular design are best taken as being 4 feet long, 4 feet wide, and 3 feet high. In the case of the two circular types, the diameter should be 5 feet, and the height of wall or ramp 3 feet 6 inches.

(iv) Another effective camp incinerator is one suggested by the Americans. It consists of a circular, shallow, saucer-like depression dug out from the ground, measuring 10 feet in diameter, and not more than 2 feet deep in the centre, from which point it should gradually shelve up to the level of the ground at its edge. The whole of this saucer-like hollow must be lined with large stones or broken bricks, and with the same materials a low wall built up all round it, the excavated earth being packed against it to prevent surface water gaining access to the depression, and also to provide a sloping approach for tilting refuse into it. Next, a cairn or pyramid of large stones must be built up in the centre of the saucer-like basin ; this pyramid should rise so as to have its top some 2 feet or more above the level of the rim or encircling wall (Fig. 16). The object

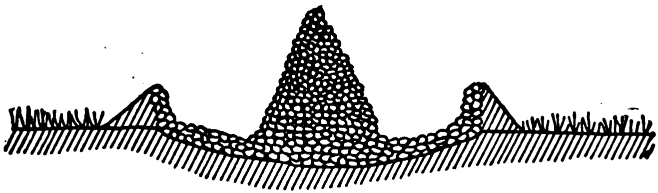

FIG. 16.—CAMP INCINERATOR (STONES).

of the central cairn is to provide a steady draught through the centre of the burning material. Ordinary dry wood or brushwood must be used to start the fire, and after it is well burning it can be maintained by steadily adding refuse. The stones soon become intensely hot, and serve to dispose of liquid and damp stuff with rapidity. This incinerator is eminently adapted for stony or rocky country. In places where boulders or large stones or broken bricks are not procurable, a similar incinerator can be devized by using empty tins of all kinds and sizes. If not utilized in exactly the same way as suggested for the stone-made design, the tins may be stacked in heaps about 4 feet high ; upon and around these heaps should be piled the miscellaneous combustible rubbish, and the whole then set alight. The tins serve to keep an air-space and generate an under draught causing the whole heap to burn fiercely. The burnt tins can be used over and over again. Ultimately all tins and broken hardware should be buried and on no account be left lying about to mark the site of an abandoned camping ground.

(v) No difficulty should be experienced by sanitary squad cadets or others in constructing and using camp incinerators of any of these designs, but it must be understood that initiative, ingenuity and common sense must be shown. Assuming the refuse to be burnt be added with ordinary care and the potency of the draught-trenches or holes maintained by judicious raking out, an enormous amount of material can be disposed of in a few hours. Once a fire is burning fiercely in any of these ininceratora, a considerable amount of even fæcal material from the latrine buckets can be disposed of and

destroyed by fire. Of course, in attempting this, special caution is needed not to cause needless offence to the vicinity. Further, it must be borne in mind that when turf sods are cut for the making of any of these improvised incinerators, care should be taken to cut them as sods which should be stored in the immediate vicinity, so that on dismantling the arrangement the turf can be replaced neatly whence it was cut, patted down and the locality left reasonably tidy.

(vi) For more or less permanent camps, large quantities of manure, litter, and general rubbish can be effectively burnt in a single apparatus which may be described as a large trough made of iron-work raised 2 feet from the ground. Bands from forage bundles or any wire or pieces of iron can be utilized to make an arrange-

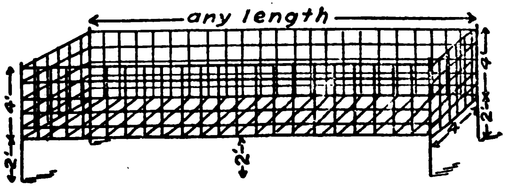

Fig. 17.—Camp Incinerator (Wire Frame).

ment as shown in Fig. 17. Such a trough may be of any length, but should be 4 feet wide and deep. It must be placed broadside to the wind, and the bars forming the bottom made to run from side to side, not lengthwise. The mesh is best made 5 inches square. In this wire trough rubbish burns freely. If ordinary railway rails are available in any quantity an excellent grate or grid can be made by arranging a dozen rails each 10 feet long as a circular cone, with the upper ends securely lashed together by stout wire and the lower ends placed on the ground so as to form a circular base some 5 feet in diameter. Around the central pyramid of rails, grates are

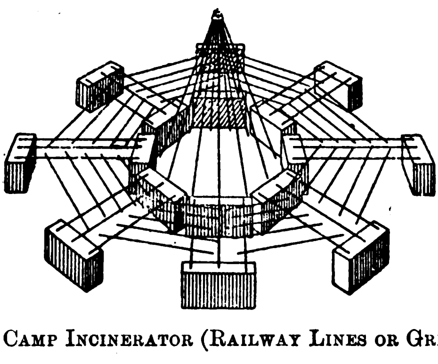

Fig. 18.—Camp Incinerator (Railway Lines or Grid-type).

arranged rapidly. These grids or grates are made of other lengths of rail resting on low turf or brick walls raised about one foot high. The radiating grids are joined together by lengths of rail. Seen from above the whole would have the appearance as shown in Fig. 18. On this large circular grid enormous masses of litter, refuse, manure, and even fæculant material can be made to burn freely, as the arrangement lends itself to free draughts of air through the mass. The only serious difficulty is to get a sufficiency of rails or iron rods so as to lay the horizontal grids close enough together to prevent litter falling through. This arrangement is obviously only feasible in a permanent camp, but once constructed is capable of coping with enormous quantities of combustible material.

91. Disposal of Excreta.—The proper disposal of this material is vital to the sanitary interests of all, but provided ordinary intelligence be exercised it presents fewer difficulties than might be expected. The moment a camp or bivouac is about to be formed or occupied the first duty of the commanding officer is to secure and protect his water supply, and at the same time to send forward his sanitary duty cadets for the location and preparation of latrines and urinals. The construction of these necessaries must not be delayed until the tents are pitched and other camp duties have been performed; no matter how temporary the halt may be, the location and completion of these places is an urgent necessity demanding prompt action, and to be supplemented by the detailing of sanitary police to prevent surface contamination of the camp area by casual easement. Certain military circumstances are conceivable when the construction of latrines may be delayed; under these conditions, to avoid surface pollution, some carefully selected spot must be marked off for the reception of excreta, and sanitary discipline enforced to see that the cadets resort to this spot only. At the earliest opportunity all excrement so deposited must be buried or covered with earth by the sanitary duty cadets.

92. (i) The general location of latrines will depend upon the direction of the prevailing wind and the position of the water supply, the rule being to place them to leeward of the camp and in such a position that no possible fouling of the water supply can result. The exact position of these places should never be left to the discretion of any officer other than the sanitary officer or such other officer of the medical corps as may be exercising sanitary supervision of the command. Latrines and urinals should be as far removed from the tents as is compatible with convenience; under ordinary conditions this may be put at 100 yards. The latrines must be placed as far as possible away from the kitchens and other places where food is prepared or stored. The extent of latrine accommodation in camps will vary according to whether the area is for temporary or permanent occupation; in bivouacs it should be 3 per cent., for ordinary camps occupied for a few days it should be 5 per cent., and in those intended for longer occupation at least 8 per cent. These figures may be taken to represent either yards or actual seats, according to circumstances. The multiplication of latrines is un-

desirable, as one or two fairly large ones are easier of control than several smaller ones, and soil pollution is also more localized.

(ii) In permanent camps, latrine accommodation will best take the form of pail-middens with dry earth, fitted with rough wooden seats, and arranged as shown in Fig. 19. This design of fixed latrine provides urine-troughs for urination which may either drain into tubs or other receptacles or into soakage-pits, conveniently placed. This latter arrangement is undesirable unless the ground is very porous and absorbent, but even then the liquid needs frequent covering over with fresh earth. In the majority of cases,

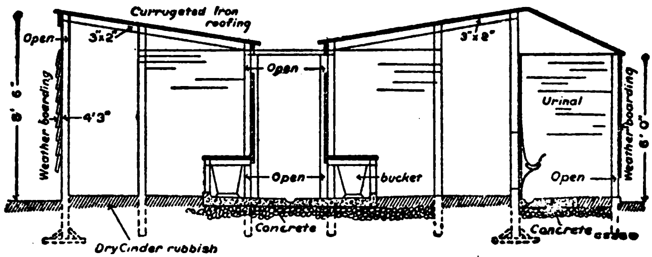

FIG. 19.—DIAGRAM SHOWING LATRINES FOR FIXED CAMP.

for the reception of urine iron tubs are usually provided, these being placed adjacent to the ordinary latrines for day use, and during the night at selected points convenient for the tents. The contents of the various receptacles should be removed daily and buried well away from the camp site. The ideal latrine is one provided with pails, each of which has a watertight cover fixed by a bayonet catch. When the receptacles are full the covers are applied, and the covered receptacles are then placed in a cart for removal to the area chosen for disposal. Here the pails are emptied, thoroughly cleansed, and then brushed over with paraffin oil. This procedure is more sanitary than emptying the pails into a supposed water-tight cart, which has to be again emptied and cleaned on reaching the disposal area. In practice these carts are rarely water-tight, and the contents are often spilled during transit. The carts are also difficult to empty without fouling the ground adjacent to the pit or trench which receives the dejecta. If portable middens, such as pails, are not provided, then the seats must be placed over pits or trenches specially dug. Whatever form the latrine takes, its successful management depends absolutely upon rigid adherence to the rule that the excreta must be quickly and completely covered over with earth, and this depends again upon the enforcement of individual sanitary discipline, adequate personnel and competent administrative control and supervision. To secure this, the following conditions must be observed: (1) the number of pails provided to be double the number of latrine seats; (2) removal of the pails and their contents

to be carried out in daylight, say between 5 and 7 a.m. ; (3) when the pails in use are removed, clean ones containing a little dry earth to be placed in position ; (4) the earth to be dry, not wet, and sufficiently broken up to pass through a half-inch mesh ; (5) the supply of earth to be kept under cover : this is conveniently divided into two compartments, namely, one for a supply of earth to get properly dry before the contents of the other are used ; (6) boxes or receptacles at each latrine seat to hold dry earth ; (7) a scoop to be provided for each of these small receptacles ; (8) the constant attendance from "reveillé" to "last post" of a cadet at the latrine to remove pails which are full, and to replace in lieu thereof clean ones, and to maintain constant supervision that the contents are covered with earth ; (9) the excreta to be moved daily to a point at least half a mile from the camp.

(iii) For the ordinary or more or less temporary camps the usual latrine is a trench, provided or not with a seat. These trenches may be either long and deep, or short and shallow If the long and deep trench system be used, a trench 20 yards long, 3 feet deep, and 16 inches wide is the necessary allowance for each hundred cadets ; this seats five per cent. of troops and allows a yard per cadet. The greatest care should be taken to prevent the water supply being fouled by these trenches, either directly by soakage, or indirectly by surface water in wet weather flowing from the trench or its immediate neighbourhood. The great difficulty about all latrines of this kind, no matter whether they have seats or not, is the fact that the front edge of the trench soon gets wetted with urine and the front of the latrine rapidly becomes a urine-sodden quagmire, the mud from which gets carried back into the lines and tents on the cadets' boots. In the not remote chance of there being one or more undetected cases of enteric fever among the command, the possibilities of infection from this source are not difficult to imagine. To remedy this, the latter practice has been to dig not one long trench but a series of short trenches in parallel, across which the user straddles and readily directs both solid and liquid excreta clear into the cavity, without soiling the sides. The trench on the short and shallow system should be 3 feet long, 2 feet deep, and 1 foot wide, and the interspace between each trench not more than three feet--preferably two and a-half feet if the nature of the soil permits, so as to preclude the cadets using the trench otherwise than in the straddling attitude. These short trenches are far cleaner than the long type, they entail less labour to dig, and are more efficiently filled up and renewed. If available, a seat in the form of a stout pole can be laid at right angles to the trenches, supported on forked uprights. A back-rest may be formed by a similar pole, but is often omitted.

(iv) It is usual to allow five short and shallow trenches for every 100 cadets, but when the numbers of cadets are 500 or upwards three per cent. of trenches suffice, that is, 500 cadets can do very well with 15 trenches. As a rule, a trench lasts only one day. A trench can be made to last longer if the contents, which tend to get heaped up

in the centre, are levelled off and if the earth used for covering the excreta be finely broken up. If the space available is limited and the trenches are not filled in one day, a fewer number may be provided. The interspace of 2½ feet is convenient and usually ample when the soil is firm, not sandy or crumbly. It allows plenty of room for another trench to be dug in it and the cadets using the second trench have nine inches of firm ground for each foot and there is an economy of space. A 3-foot interspace has the advantage of allowing more room between trenches, but it entails a longer frontage, more than is available with a minimum camping ground, and it also requires a greater length of screen.

The method of making and laying out these short and shallow trenches will be gathered from Figs. 20 and 21. Suppose B is the

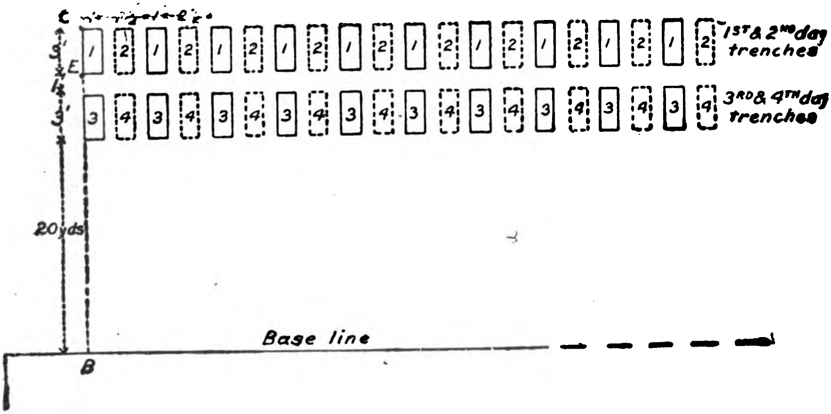

FIG. 20.—DIAGRAM SHOWING HOW TO LAY OUT LATRINES IN CAMP.

base line of the camp and that latrine trenches are to be dug to the rear; that the number of cadets is 200, and the probable length of occupation is thirty days. For this small number 5 per cent. must be allowed, or ten trenches daily, if over 500 cadets were present 3 per cent. only could be allowed. The frontage in yards required may be calculated as being six times the number of hundreds of cadets present, that is 200 cadets will need 12 yards of latrine frontage. The depth for latrine area is two-thirds the number of days' stay. In this case, the occupation being probably thirty days, the required depth will be two-thirds of 30, or 20 yards.

From B, and at right angles, measure off 20 yards, or BC, and drive in a peg at C. From C, take the line CD parallel to the base of camp and measure 12 yards. This line CD equals the line

of first row of trenches. From C, along CD, measure off 1-foot and $2\frac{1}{2}$-feet spaces alternately, marking the spots with a spade till there are ten 1-foot spaces. To do this, it is convenient to use a stick which is 3 feet long and marked at 1 foot and $2\frac{1}{2}$ feet, or a cord looped at one end and marked by pieces of coloured rag, From C measure 3 feet, CE. From E and parallel to CD mark off alternate spaces as before and join up. This outlines the first row of trenches. Next, remove the upper sod of each trench in one piece as far as possible, and put it about 3 feet behind the trench. Excavate the trenches till they are a clear foot deep, keeping the sides vertical, and placing the excavated earth immediately behind the trenches between it and the sod. This earth must be finely broken up. Surround the trenches with a canvas screen, the back being 3 feet behind and the fore-part at least 6 feet in front of the trenches. The entrance should be in the centre of the front and have a 6-foot overlay. The length of screening necessary for 1,000 men on a 5 per cent. basis will be 130 yards ; if twenty-five trenches are used, they will require 70 yards.

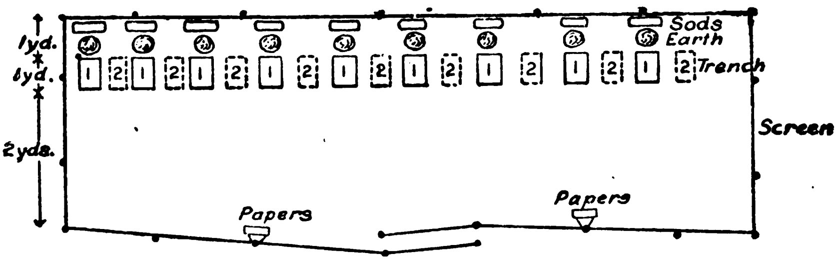

FIG. 21.—DIAGRAM SHOWING HOW TO LAY OUT LATRINES IN CAMP.

On the second day, fill in the trenches with the remaining excavated earth, replace the sod, tread and beat down firmly. The advantage of the large upper sod is now obvious. Dig the second day's trenches in the interspaces of the first row. On the third day, dig a row of trenches similar to and parallel with the first row and one foot in front of them. Move the screening forward so as to surround them properly. Repeat the construction of trenches on the subsequent days in a precisely similar manner. After the latrine has been prepared, examine the slope of the ground and, if necessary, dig a shallow drain to divert surface water from the trenches, taking care that it does not flow on to the ground in front of the trenches, which will have to be used later on. This precaution applies also to urinals.

For covering the deposited excreta with earth, some kind of implement such as one or more spades, scoops, empty tins, or tin-

lids must be provided near each trench for replacing earth and covering the filth over. Kicking the earth in by the foot is certain to be a failure and should be discouraged, as conducive to imperfect covering of the excreta, and consequent slackness. Cadets must be told the necessity for covering their dejecta; this precept cannot be impressed upon them too often. Failure on their part to cover their excreta properly should be made a matter of discipline, and systematically punished.

(v) Considerable supervision is required over all latrines, and their proper administration is a most important factor in the preservation of the health of cadets living in camps or bivouacs. One rule only must dominate the successful working of these places and that is all excreta must be covered up as soon as possible with earth, not only for mere purposes of deodorization, but to preclude the access to it of flies. These insects are one of the great means by which this filth and the associated germs are carried to man and his food. The practical problem is, how is this systematic and instant covering of excreta with earth to be secured and who is to do it? Is each individual cadet to cover his own filth or are special cadets to be detailed for this particular purpose? Where ordinary earth-closets or pail-middens are fixed in camps there should be no difficulty in providing a number of boxes of dry earth with the necessary scoops, and so enabling, with the least trouble, each individual to cover his own fæcal deposit. This is the proper way for it to be done. In other camps, where the ordinary trench-latrine only exists the situation is not so simple. In the first place the available soil is less conveniently placed, the provision of a sufficiency of spades or scoops is not always practicable, and the whole surroundings of the place conduce to a hurried rather than a leisured resort on the part of the individual. The remedy lies in strict enforcement of discipline and compulsion of the cadets to cover up their own excreta with earth at the latrines; moreover, a sanitary patrol or policeman must be placed over the latrine to see that each cadet fulfils his duty to himself and his neighbour. The only alternative to this is to place a cadet within the screen, provided with a spade, and direct him to cover each deposit with earth as each depositor moves off. In either case, the tour of this latrine duty should not exceed two hours, and in the early part of the day might well be limited to one hour. So long as the sanitary foresight of cadets remains at the present low level, the latrine sentry, however great the sentimental objections may appear, is a necessity. The question arises, where are the latrine sentries to come from? Are they to be drawn only from the sanitary detachment or from the unit as a whole? Clearly, the latrine sentry must come from the whole unit as being the best means of imbuing the minds of all concerned with their own personal responsibilities in protecting the health of their own unit and the army at large. The tour of duty should be short, say one to two hours, and the interval long. Consistent practice on these lines will soon lead to a great change for the better in the care and management of these places.

When this is so, the incidence of filth originated or dust and fly-borne disease in camps will be sensibly lessened.

The condition of all latrines should be verified personally by the orderly officer of the day at least once during each twenty-four hours So soon as the latrine trenches have been filled in to within six inches of the ground level their use should be discontinued, earth thrown in and the turf or sods replaced. On the abandonment of a camp or a bivouac, all the latrine trenches must be filled in and the site marked as foul ground.

(vi) From time to time a variety of excreta-incinerators have been suggested. Experience has shown them to be unsuccessful except when dealing with small quantities of fæcal material; they certainly are not suited for general use by troops constantly on the move. In fixed camps, much more could be done than is usually attempted in this direction by burning the latrine-pail contents with ordinary refuse and litter in one or other of the refuse-incinerators which have been described. In so doing, care must be taken not to create an offensive smell or nuisance, but in the light of practical experience the objections from this cause are not so great as many suppose. The essentials for success are: (1) Start with and maintain a fierce fire; (2) add the excreta slowly; and (3) only attempt to burn the solid material; the liquid must not and cannot be disposed of by fire.

93. In all camps, where ordinary receptacles are not provided, pits or trenches must be dug for the purposes of urination. For day use, these *urinals* are best placed within the screen and adjacent to the latrine trenches. Given a reasonably absorbent soil, the urine soon disappears, but it may be that such will not occur; in this case, care must be taken to make supplementary pits, while at all times the exposed urine-sodden soil must be covered at least three times a day with clean dry earth to protect it from flies. For night use, when special urine-tubs cannot be provided, or when the day urine-pits are any distance from the tents, it may be necessary to dig shallow urine-pits near the cadets' lines into which they can micturate at night. This is a practice which should be resorted to as rarely as possible; at all times such pits must be carefully filled in at dawn. Urine-tubs can be extemporized easily from empty oil-tins, which may with advantage be partly filled with grass, chopped straw, saw-dust, earth, or any other absorbent material. These tins should be mounted on boxes or on rough wooden trestles, to reduce to a minimum all chance of splashing or spilling.

A variety of improvized urinals can be planned for camp use. These will best take the form of shallow trenches, at least 2 feet wide, leading into a pit filled with large stones, the trench being for urinating into, and the pit to take the excess which fails to soak into the soil. Roughly, two trenches, each 8 feet long, will suffice for a battalion of full strength. The gradient should be a fall of one inch to the foot. The catch-pit will vary in depth and size according to soil and number of cadets using the trenches; one 3 feet deep and 3 feet in diameter in a moderately porous soil should

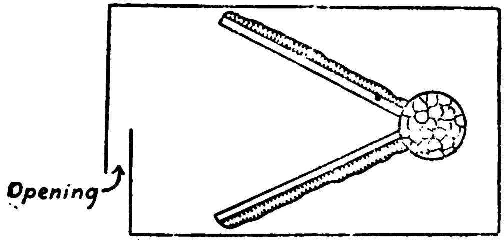

FIG. 22.—PLAN OF CAMP URINAL.

suffice for 800 to 1,000 cadets. Fig. 22 shows a typical example of one of these rough urinals. The trenches will last about two days and the pit some eight days ; when foul, new trenches can be dug as radii from the pit and the old ones filled in and all grass sods replaced. In some cases it may be feasible to screen off the pit to prevent cadets actually micturating into it, shifting the screen with the trenches, or, better still, cover the pit with sods supported on stakes, and leave apertures by which the contributing trenches may drain into it. The ground around a urinal should be burnt when another has to be dug or the camp evacuated.

93A. Much of the success or failure in regard to efficient sanitary control of an encampment depends upon the planning or arrange-

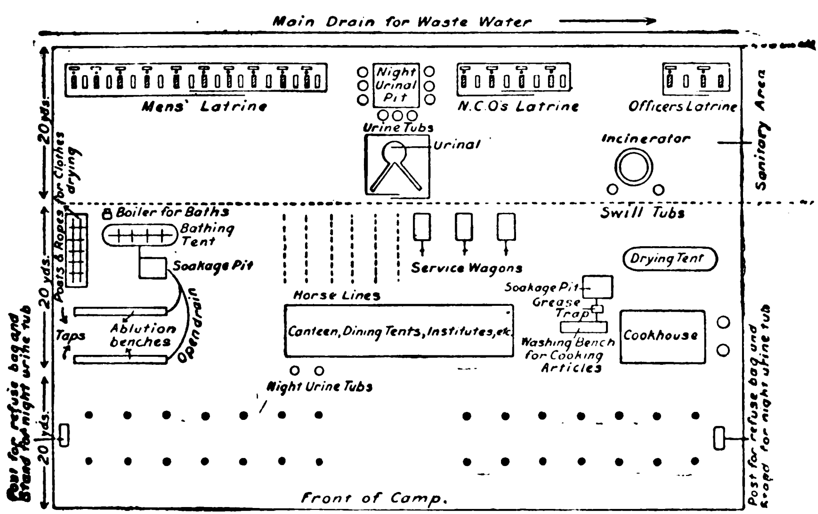

FIG. 23.—PLAN OF CAMP.

ment of the area. To a large extent this again depends upon the extent of land available. Assuming that the space is equivalent to that officially laid down, the various sanitary arrangements, such as cooking places, washing places, incinerators, latrines, and urinals should be located in the rear of the tents in what can conveniently be termed the "sanitary area." As a general guide as to how these arrangements can be located, Fig. 23 may well serve as a type. Conditions vary so much that no official plan is recognized, but each case must be judged on its merits.

In closing this subject of the sanitary control of the camp, it is desirable to emphasize the fact that much of its successful practice depends upon the exercise of care and personal initiative. This is required not only of the cadets, but of the officer; there can be little doubt that the cadets in all these matters will and must take their cue from the officer. The essential principle of sanitation in the camp, as elsewhere, is *cleanliness.* This state of cleanness must not only be maintained while the camp is occupied, but on evacuation the camp area must be left sweet and tidy, so that those coming after may not suffer from a heritage of filth. The surest index of the cleanliness of cadets and places is the absence of flies, for if there is no dirt or filth to feed upon the fly will not be present.

CHAPTER IX.

THE TRANSPORT OF THE WOUNDED.

94. Means of Transporting Wounded.—The transport of the wounded is carried out by the following means :—By cadets; by conveyances carried by cadets; by conveyances wheeled by cadets; by animals; by conveyances carried by animals; by conveyances drawn by animals; by mechanical transport; by railway transport and by water transport.

95. The importance of a suitable choice, and of adequate preparation, is illustrated by the following remarks of Sir Thomas Longmore; "Every man who is rendered helpless by a severe wound naturally feels an urgent desire to get surgical aid as quickly as possible, as well as to be removed from the place of fighting, where he can no longer be of use, to a place of comparative security. But it is not merely the gratification of this longing for help that has to be thought of: it is the more serious fact that the safety of lives and the preservation of limbs in many instances will depend upon proper means of transport being at hand. Moreover, in almost all cases the efficiency of the surgical assistance rendered will be materially influenced by the time which has elapsed before the patient is brought to hospital and the care with which the transport is conducted."*

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* "Treatise on Ambulances," by Surgeon-General Sir Thomas Longmore, C.B., &c. (out of print).

96. Wounded are carried out of action either pick-a-back, by the back-lift, fireman's lift, hand-seats (*see* para. 139), or on stretchers, for removal to the tent division.

97. Pick-a-back.—If conscious, and able to hold on, a cadet can be carried pick-a-back by another. The improvized seat shown in Fig. 24 adds greatly to the comfort of the wounded and eases the bearer carrying him.

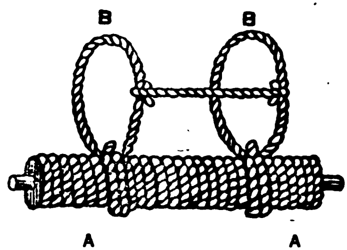

FIG. 24.—IMPROVIZED SEAT, AS AN AID IN CARRYING A MAN PICK-A-BACK.

Made of twisted straw, &c., wound round a strong stick or pole.
AA.—The seat. BB.—Arm-loops for bearer.

98. The Back-lift.—If able to stand, place the patient with his back to yours, slightly stoop, place your hands over your shoulders and grasp the patient under the arm-pits, bring his weight

well up into the small of the back, and stand up (Fig. 25). To lower the patient to the ground, sink down on left knee, place him in a sitting posture, and turn towards the patient.

FIG. 25.—THE BACK-LIFT.

99. The Fireman's Lift.—If a patient is helpless he may be carried by means of "the fireman's lift" (Figs. 26, 27 and 28).

THE FIREMAN'S LIFT.

FIG. 26.

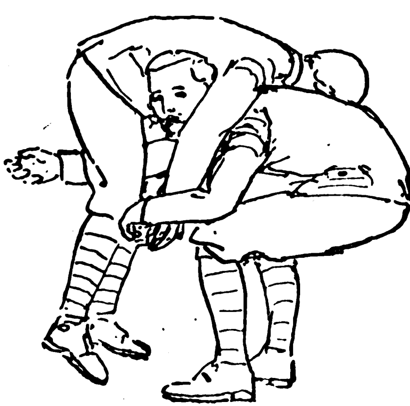

FIG. 27.

FIG. 28.

This method is well adapted for cases of insensibility, and is carried out as follows :—

(i) Roll the patient over on the face, the arms to the side.

(ii) Stand at the head, place your hands beneath the patient's shoulders, and raise him to the kneeling position (see Fig. 26).

(iii) Place your hands under his arm-pits, raise him up, stoop, place your head beneath his body, bring his right arm around your neck, put your right hand round his right thigh, bring his weight well on to the centre of your back (Fig. 27), grasp his right wrist with your right hand and rise to the erect position (Fig. 28).

100. With two bearers.—If the patient is insensible, one bearer, kneeling behind him, passes his hands under his arm-pits and clasps them in front of his chest, the second bearer carries him feet first with a leg on either side. If the lower limb is injured, both legs should be tied together and carried in a horizontal position.

101. By puttees or pugarees.—Wounded may be carried off the field by means of putties or pugarees :—

(i) *By means of one puttee.*—A puttee is unrolled and placed well forward under the buttocks of the wounded and tied by a reef-knot into a loop 84 to 88 inches in length (Fig. 29). The rescuer then bends down, facing away from the injured, and applies the loop of puttee over his own forehead, and, rising, carries off the patient (Fig. 30). The webbed stretcher-sling can be similarly used.

(ii) *By means of two puttees.*—One puttee is placed under the buttocks of the patient and over the forehead of the rescuer, as before. The second puttee is passed outside the first, round the middle of the back and under the arm-pits of the patient, under the arm-pits and over the front of the chest of the rescuer, and tied off at one side by a reef-knot, thus forming a loop 72 inches in length (Fig. 31).

FIG. 29.—APPLYING ONE PUTTEE.

Fig. 30.—Using One Puttee.

Fig. 31.—Using Two Puttees.

CONVEYANCES CARRIED BY CADETS.

102. All such forms of hand ambulance transport are comprised in the general term "litter"; but can be divided again into hammocks and stretchers, and other varieties confined to the East such as jhampans, dandies, doolies and palkis.

The stretcher proper is composed of poles, traverses, canvas (or stout cloth), slings, and is possibly provided with feet and pillows. Every army has its own particular pattern of stretcher.

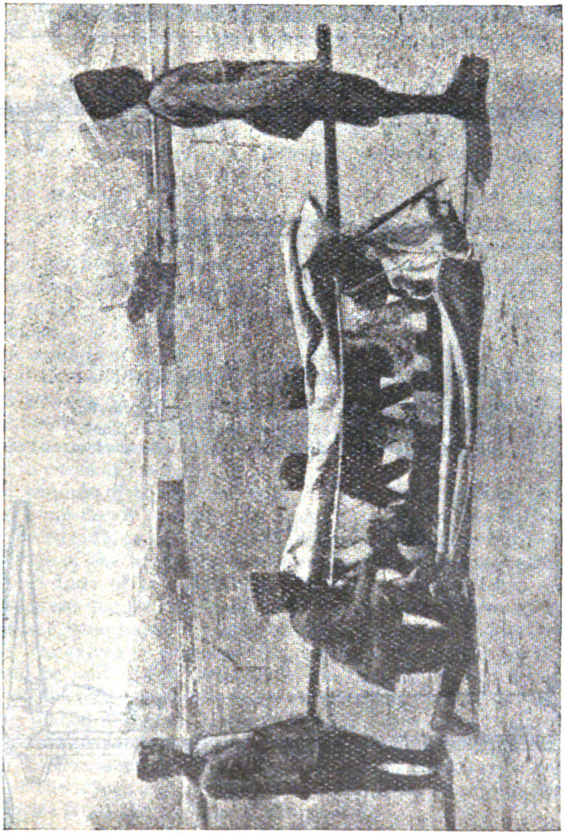

FIG. 32.—THE INDIAN ARMY PATTERN DANDY.

103. Army Pattern Ambulance Stretchers.—The ambulance stretchers in use in the British Army are those known as Mark II. A third pattern, fitted with a hood, is known as Special Mark I.

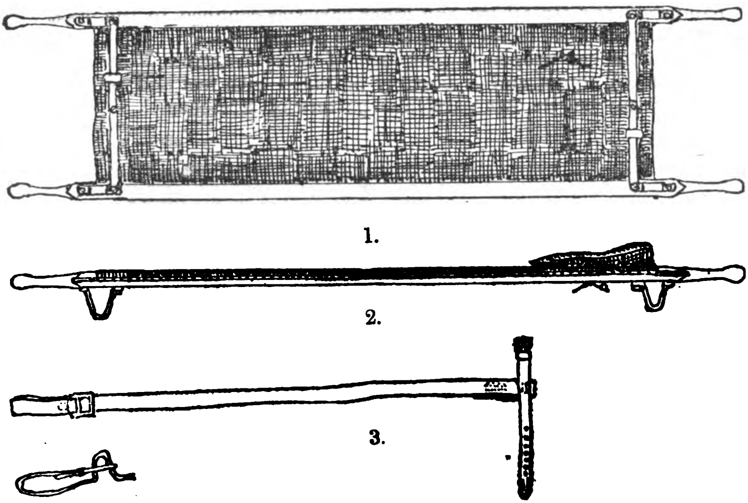

FIG. 33.—AMBULANCE STRETCHERS, MARK II.

1. Plan of underside of stretcher showing traverses.
2. Side elevation of stretcher with cushion in place.
3. Sling and detail of adjustable loop in lateral view.

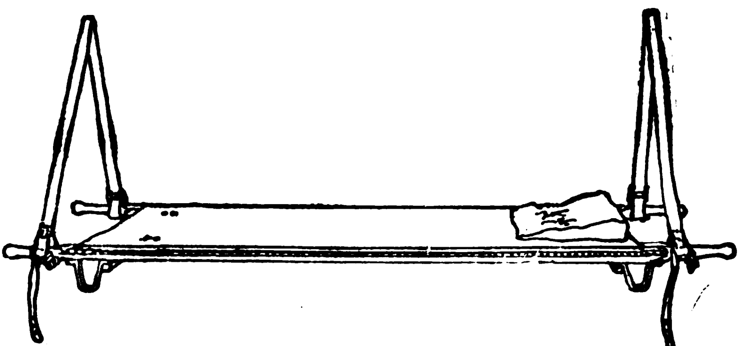

FIG. 34.—AMBULANCE STRETCHER, MARK II.

104. In Mark II stretchers (Figs. 33 and 34), the canvas, which is tanned, is fastened to the pole by copper nails through an edging of leather; the poles are square and kept apart the required distance by two flat, wrought iron, jointed bars called traverses, and are fitted on the underside with steel U-shaped runners. A pillow and a pair of shoulder-slings are provided with each stretcher. The pillows are wedge-shaped, varying from 1½ to 3½ inches in thickness. There are eyelet holes in the canvas of the stretcher at both ends for the attachment of the pillows by thin leather thongs. The sling, which is of tanned web, has at either end a loop, one of which is furnished with a brass grip-plate, by means of which the sling can be lengthened or shortened; at the opposite end is a narrow, transverse strap fixed at right angles, which is buckled round the stretcher when closed.

105. The special Mark I ambulance stretcher is fitted with a collapsible hood for use in hot climates or for protection from the rain, and with four hinged handles, two on each side, so that it can be carried by six bearers. It is also provided with four shoulder-pads.

106. General Rules for the Carriage of Stretchers.—(i) *Consideration of the Nature of the Injury.*—Special care should always be taken to notice the part injured and the nature of the injury, as these determine in a great measure the position in which the patient should be placed during transport. In all cases the head must be kept low, and on no account pressed forward on to the chest.

In wounds of the head, care must be taken that the patient is so placed that the injured part does not press against the conveyance.

In wounds of the lower limb, the patient should be laid upon his back, inclining towards the injured side, this position being less liable than others to cause motion in the broken bone during transport in cases of fracture.

In wounds of the upper limb, if the patient requires to be placed in a lying-down position, he should be laid on his back or on the uninjured side, as in the cases of fracture there is less liability in these positions of the broken bones being displaced during transport.

In wounds of the chest there is often a difficulty in breathing; the patient should be placed with the chest well raised, his body at the same time being inclined towards the injured side.

In transverse or punctured wounds of the abdomen, the patient should be laid on his back, with his legs drawn up, so as to bring the thighs as close to the belly as possible, a pack or other article being placed under his hams to keep his knees bent. If the wound is vertical the leg should be extended.

(ii) *Adjustment of Slings.*—Care should be taken at starting to adjust the slings so that the parts supporting the poles are at equal distances from the surface of the ground.

(iii) *Carriage of Patient.*—The patient is usually carried feet first but in going up hill the position is reversed, and the patient is carried head first. To do this the bearers will lower the stretcher

and turn about. If the patient is suffering from a recent fracture of the lower extremity he will, in all cases, be carried with his head down hill. The stronger and taller bearers should be down hill.

(iv) *Carriage of Stretcher.*—In all circumstances the stretcher should, as far as possible, be carried in the horizontal position, which may be maintained in passing over uneven ground by raising or lowering the ends of the stretcher.

It is an important matter for the bearers to practise the carriage of stretchers, so as to acquire skill in keeping the stretcher level on uneven ground. The bearers trained and habituated to this duty perform it with ease and dexterity, irrespective of difference in their heights, while those who have not practised it are not unlikely to cause considerable distress to the patient when they have to carry him up and down hill. Concerted action of the front and rear bearers is necessary ; each must be aware what part he has to perform, and must instinctively raise or lower his end of the stretcher in order to counteract the effect of one bearer being temporarily higher or lower than the other. Facility in this can best be acquired by practising the carriage of the stretchers up and down steps, or over uneven ground.

On no account will bearers carry a stretcher with the poles on their shoulders, as it is necessary that one of them should have the patient in view. In the event also of the patient falling from such a height, owing to one of the bearers tripping or being wounded, his injuries might be considerably aggravated.

(v) *Passing a Wall or Fence.*—No attempt will be made to carry a patient over a high fence or wall, if it can possibly be avoided, as such is always a dangerous proceeding. A portion of the wall should be thrown down, or a breach in the fence made, so that the patient may be carried through on the stretcher ; or, if this be not practicable, the patient should be carried to a place where a gate or opening already exists, even although the distance to be traversed may be increased by doing so. It is better to do this than risk the safety of the patient.

(vi) *Crossing a Ditch.*—On arrival at a ditch to be crossed, the No. 4 of the stretcher squad will select a level piece of ground near its edge where the stretcher will be lowered.

The bearers will then take up positions at the stretcher as in loading wagons. The stretcher, with the patient on it, is then lifted and carried as near the edge as possible and lowered to the ground.

The Nos. 1 and 4 bearers descend into the ditch, lay hold of the handles of the stretcher, and, lifting it, draw it forward ; the remaining bearers in succession descend and take hold of the stretcher, which is then pushed forward to the opposite side, and the front pair of runners rested on top of the bank.

The Nos. 1 and 4 bearers now climb up and guide the stretcher which is pushed forward by the other bearers until both pairs of runners rest on the ground. The remaining bearers climb up, and the whole, lifting the stretcher as in loading wagons, carry it

forward clear of the ditch and place it on the ground, the bearers taking up positions as in "prepare stretchers" (Chap. XXII). The No. 4 bearer will then examine the patient with a view to re-adjusting dressings, &c., if necessary, after which the march will be resumed.

The necessary words of command for lifting and lowering stretchers, &c., will be given by the No. 4 bearer.

(vii) *Crossing a Canal or River, when no boats or bridges are available.*—In this case it is necessary to improvise a raft on which one or more stretchers can be placed. This can be done as follows :—Dig a trench 7 feet by 7 feet by 3 feet; take a large tarpaulin, or cover of a wagon, and spread it over the bottom of the trench, leaving enough tarpaulin to fold over and bind when the trench is filled; next fill the tarpaulin as tightly as possible with cut brushwood firmly stamped down, and cover with the spare folds of the tarpaulin. Then take it out, bind with strong ropes and fasten securely. Float the raft, and secure the stretcher to the ropes in such a manner as will keep it level when loaded. The whole can then be floated across with the assistance of the bearers.

107. The Improvization of Stretchers, Litters, &c.—The improvization of stretchers is not difficult, bearing in mind the principle of their construction, viz., some secure material upon which a patient can lie and be carried by cadets. Before any improvized apparatus is used, it must be practically tested by one of the party, in order to avoid the possibility of further injury to the patient from defective materials or construction. The materials necessary are generally to be found in the neighbourhood of operations, *i.e.*, doors, gates, hurdles, shutters, shafts, saplings, broom-handles, corn-sacks, tarpaulins, old tents, stout pieces of cloth, great-coats, hay, straw, ferns, leaves, &c., &c., all of which have their use.

A gate or door taken off its hinges, or a hurdle, are ready means of carriage, if at hand.

108. The hammock is the simplest special contrivance for carrying a sick cadet, and a soldier's blanket slung between two cadets, or tied to a pole carried on their shoulders, offers perhaps the most primitive form.

109. By means of blankets, canvas, or sacks, an improvized stretcher can be formed with a couple of poles. A horse-blanket with two or three lances passed through several slits on each side would serve to carry a cadet for a short distance.

A loop may be sewn at each corner of a blanket, which is then doubled over so that the two loops at each end are brought together. A pole (preferably of cedar, pine, ash or bamboo) is then passed through the four loops on one side, and another passed within the doubling of the blanket on the other side. This forms a secure and comfortable stretcher for a short distance.

Again, a good temporary litter can be made by laying two stout poles on the edges of a blanket, rolling the edges inwards, and finally making them fast by strong twine passed through holes cut

in the blanket at intervals of about a foot along the poles and tied off strongly on the outside.

A length of blanket sewn on to bamboo poles makes a light serviceable stretcher; but, like the preceding forms, it has no traverses, and a stretcher not so provided is unsuitable for carrying a case which might be subjected to injurious pressure when the stretcher is raised.

Two poles, each of, say, 8 feet in length, may be used, with two cross bars 2½ feet each, nailed or securely lashed on to each end of them, the blanket being firmly knotted to the pole. A third cross-bar placed across the centre would keep the patient from falling out. An effective cover of bent boughs supporting another blanket could be arranged over the stretcher as a protection from sun and rain.

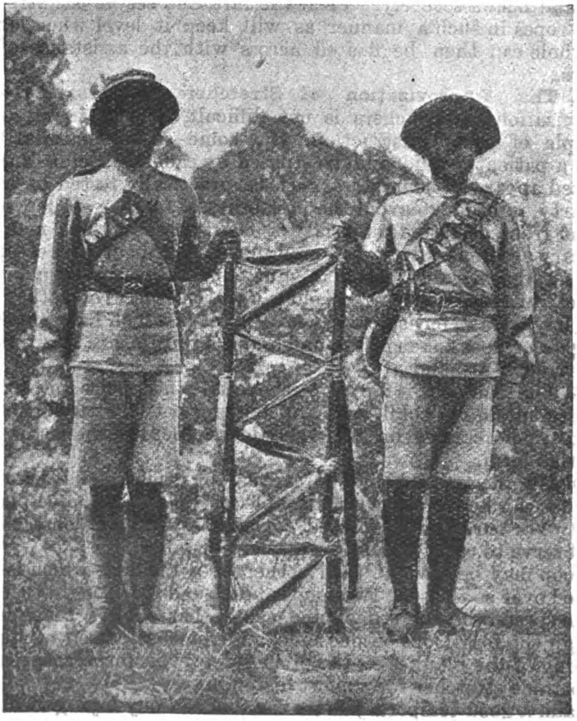

FIG. 35.—RIFLE AND PUTTEE STRETCHER.

110. Stretchers can be improvized with rifles and puttees, pugarees, &c., *e.g.* :—(i) Two puttees are applied to two rifles, forming nine bands from muzzle to butt (Fig. 35). The cartridges are withdrawn. The two rifles are placed with their trigger-guards uppermost, the two puttees being knotted to the rifles so as to form nine cross-bands uniting the rifles.

The first cross-band passes from the muzzle of one rifle to the piling-swivel of the other ; the second cross-band from the piling-swivel of one rifle to midway between the "upper band" and the "lower band" of the other ; the third cross-band from midway between the "upper" and the "lower band" to the "lower band" ; the fourth cross-band from the "lower band" to the hand-guard ; the fifth band from the hand-guard to the front of the magazine. The second puttee is then knotted to the first. The sixth cross-band runs from the front of the magazine to the small of the butt ; the seventh band from the small of the butt of the one rifle to the small of the butt of the other rifle ; the eighth cross-band from the small of the butt to the butt-swivel ; the ninth cross-band between the two butt-swivels. The puttees are applied to the rifles by a simple hitch, and fastened to such parts of the rifle as will prevent slipping. The stretcher thus formed by the puttees has a length of about 44 inches and a breadth of about 15 inches.

This method* of carrying wounded by means of rifles is useful where cadets are seriously injured. The head can be kept level, being at the butt-end, and the legs allowed to hang down at the muzzle-end of the rifles. The slings of the two rifles can be tied over the chest of the patient by means of a piece of bandage, &c.

111. Perhaps the most comfortable of all litters is that formed by one or two poles passed through a strong net.

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* Devised by Captain J. S. O'Neill. I.M.S.

PART II.

Royal Army Medical Corps Cadet Drills and Exercises.

CHAPTER I.

STRETCHER EXERCISES.

112. General Remarks.—The following exercises have been framed for the instruction of bodies of cadets, with a view to the careful handling of the wounded, and their transport on stretchers and in wagons. When the bearers have become thoroughly proficient in these exercises on the parade ground, the instructor will take every opportunity of regularly practising them under conditions approaching as far as possible to those of field service. The squads should be exercised over rough ground, and each cadet taught the various means for the transport and carriage of wounded.

113. Cadets detailed for stretcher exercises must be well grounded in squad and company drill. Knee-caps will be worn on the left knee at all exercises in which the cadets require to kneel, except when otherwise ordered. Cadets to act as "patients" will be provided with ground-sheets to protect their clothing.

Regimental stretcher bearers should be especially practised in stretcher exercises with reduced numbers, and a regimental stretcher squad should normally consist of 4 bearers.

114. For instructional work the cadets will be taught the exercises "by numbers" (where so indicated); when sufficiently advanced, the various movements will be done "judging the time," or "working by the right."

FORMATION.*

115. Sizing the Bearers.† TALLEST ON THE RIGHT, SHORTEST ON THE LEFT, IN SINGLE RANK,—SIZE.	The whole will break off and arrange themselves according to their size in single rank, the tallest on the right and shortest on the left and take up their dressing by the right.
NUMBER.	From right to left of the whole company.
ODD NUMBERS ONE PACE FORWARD, EVEN NUMBERS ONE PACE STEP BACK —MARCH.	Odd numbers will take one pace forward, and the even numbers will step back one pace.
NUMBER ONE STAND FAST, RANKS, RIGHT AND LEFT—TURN.	The odd numbers, with the exception of Number One will turn to the right, the even numbers to the left.
FORM COMPANY, QUICK—MARCH.	The whole will step off, the even numbers wheeling round to the right and following the left-hand cadet of the odd numbers. No. 3 will form up two paces in rear of No. 1, No. 5 on the left of No. 1, No. 7 in rear of No. 5, No. 9 on the left of No. 5; and so on The leading cadets of the even numbers will always form in the rear rank and the next cadet in the front rank. As the cadets arrive in their places they will turn to the left and take up their dressing.

* Previous to the parade the stretchers will be laid in a heap on the ground.

† In this and following paragraphs the name of the movement is shown in **thick type** in the left-hand column, and is followed by the caution or executive word of command, given by the O.C. or instructor, in SMALL CAPITALS. The right-hand column contains the detail.

When, however, the words of command are given by the No. 4 of the stretcher squad; these are shown in an additional (second) column, and the detail given in the third column.

116. Forming the Squads. By Fours (Fives, or Sixes)—Number.	The front rank will number from right to left in order.
Squads at the Halt, Left—Form. Quick—March. Right—Turn.	As in Infantry Training.
Right—Dress.	The No. 1 of the squad on the right remains steady; the remaining Nos. 1 will each take up positions one pace from the bearer on his right; the other bearers will place themselves one pace in rear of and covering the bearer in front of them.
	Notes.—If necessary, the bearers will be proved as follows:— *First Rank, No. 1 bearers, Stand-at-Ease.* *Second Rank, No. 2 bearers, Stand-at-Ease.* And so on. But this should be unnecessary as bearers retain the same numbers in the squad as when numbered for forming squads. When proved in this manner the squads will be called to Attention before proceeding with the next movement. Squads are composed of 4, 5, or 6 bearers. When the bearers are constantly employed in the same positions, the squads will be formed up on the command *By Squads, Fall—In,* when each bearer will take up his proper position on the No. 1 of the squad on the right.
Number the—Squads.	No. 1 bearers number from right to left.

117. Supplying Stretchers.

NO. 3 BEARERS,
RIGHT (OR LEFT)—
TURN.
SUPPLY
STRETCHERS,
QUICK—MARCH.

The No. 3 bearers will march by the shortest route to the pile of stretchers; each bearer in turn will lay hold of the near handle of a stretcher, raise it to a perpendicular position in front of him, runners to the front; stoop, grasp the lower runners with his right hand and place the stretcher on his right shoulder at the slope; rise to the erect position and lead on, stepping short.

As soon as the last bearer has provided himself with a stretcher he will give the command *About—Turn.* The whole will turn about, and rejoin their squads in quick time, halting without further word of command as they arrive in their places. Taking the time from the leading bearer they turn to the right (or left).

(TWO.)

The lower handles will be rested on the ground, the stretchers held perpendicularly.

(THREE.)

The bearers will place the stretchers on the ground to the right of the squad by passing the lower handles forward, runners to the right, front-ends of the poles in line with the toes of No. 1; and rise together working by the right.

STAND TO—
STRETCHERS.

The Nos. 1 place themselves with their toes in line with the front-end of the poles, Nos. 3 with their heels in line with the rear-end of the poles, allowing sufficient room for turning. The remaining bearers will take up positions one pace in rear of and covering the bearers in front of them.

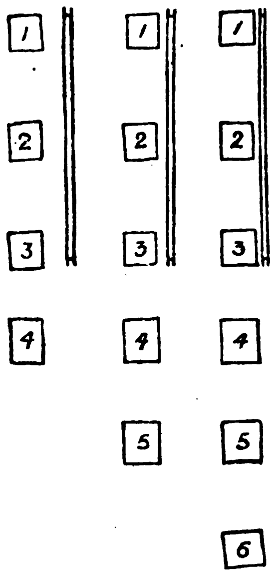


FIG. 36.—"STAND TO STRETCHERS."

118. Lifting and Lowering Stretchers. LIFT—STRETCHERS.	Nos. 1 and 3 stoop, grasp both handles of the poles firmly with the right hand, rise together holding the stretcher at the full extent of the arm, runners to the right.
LOWER—STRETCHERS.	Nos. 1 and 3 stoop and place the stretcher quietly on the ground, runners to the right, and rise smartly together.

Dismissing.

119. Storing or Piling Stretchers. Lift—Stretchers.	As before detailed.
Nos. 1 and 3, in Succession from the Right (or Left), Dis-engage, Quick—March.	The Nos. 1 and 3 on the flank named will disengage by taking a side-pace to the right, and move off in quick time followed by the remaining Nos. 1 and 3 in succession, dispose of their stretchers, and rejoin their squads.
Squads, Stand—Easy.	As in Infantry Training.
Remove—Knee-Caps.	Knee-caps are removed and collected (if necessary).
Squads, Atten—tion. Dis—miss.	As in Infantry Training.

Exercises with Closed Stretchers.

120. Advancing and Retiring. Lift—Stretchers.	As before detailed.
By the Right (or Left), Quick—March.	The squads will advance, the rules for marching as in Infantry Training being maintained, except that the hand holding the stretcher will be kept steady by the side.
Squads, About—Turn.	The whole turn about, the stretcher being passed from one hand to the other by the Nos. 1 and 3.

CHANGE—STRETCHERS.	If the squads are advancing, the Nos. 1 will pass the stretcher from one hand to the other behind them : the Nos. 3, seeing this done, will pass the stretcher from one hand to the other in front of them, the Nos. 2 moving diagonally to their places. If the squads are retiring the Nos. 1 act as for Nos. 3, and the Nos. 3 as for Nos. 1. The remaining bearers in each case continue in their respective positions.
	Note.—The stretcher must be held in the right hand when the command *About—Turn* is given. The runner must be to the left when the stretcher is in the left hand.
121. Moving to a Flank. (*See* Detail.)	When it is necessary to make a quick movement to either flank for a short distance only, the command *Right* (*or Left*)—*Turn* will be given. When a squad is marching to the right and the command *About—Turn* is given, the Nos. 1 and 3 will seize the handles of the stretcher with the left hand and cut away the right while turning about, resuming the grasp with the right hand —back of the hand to the rear—after the turn has been completed.
122. Changing Direction. AT THE HALT, RIGHT (OR LEFT)—FORM.	The No. 1 of the squad on the flank named will make a full turn to the right (or left), the remainder of the Nos. 1 a partial turn in the required direction, the other bearers a partial turn in the opposite direction
QUICK—MARCH.	The No. 1 of the squad on the flank named will stand fast, the remainder step off by the shortest route to their places on the new alignment, halt, and take up their dressing independently.
	Note.—When it is intended to move off in the new direction after forming, the words *At the Halt* will be omitted, the bearers will mark time when formed and the word *Forward* will be given.

123. Extending. FROM THE RIGHT (LEFT, OR ANY NAMED SQUAD), TO FOUR PACES —EXTEND.

On the March.—On the word *Extend*, the named squad will continue to move on in quick time, the remainder will make a partial turn outwards, double to their places and turn to their front, breaking into quick time as they arrive there and taking up their dressing by the directing flank or squad. On the commencement of the movement the Nos. 4, 5, and 6 bearers will place themselves on the right of the stretcher. (*See* Fig. 37.)

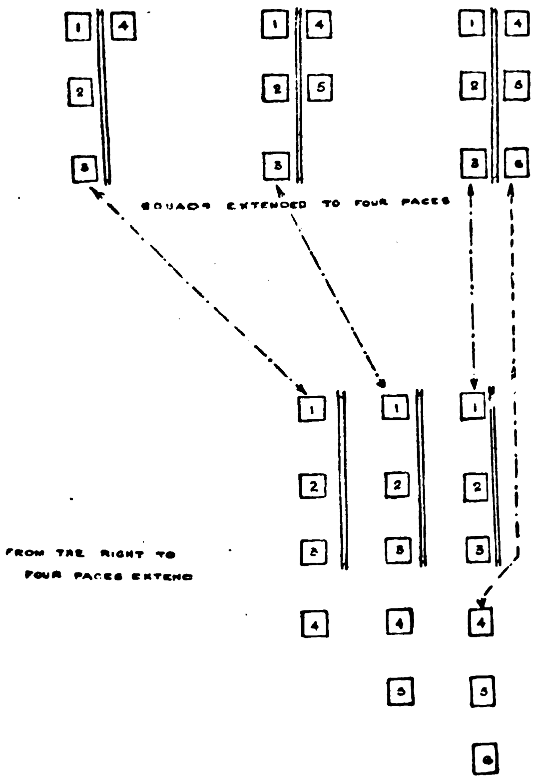


FIG. 37.—POSITION IN EXTENDED ORDER WITH CLOSED STRETCHERS.

124. Closing. ON THE RIGHT (LEFT OR ANY NAMED SQUAD),— CLOSE.	The named squad will continue to move on in quick time, the remainder will make a partial turn in the direction named, double to their places and turn to their front, breaking into quick time as they arrive there. The bearers on the right of the stretcher will drop back into their original places.

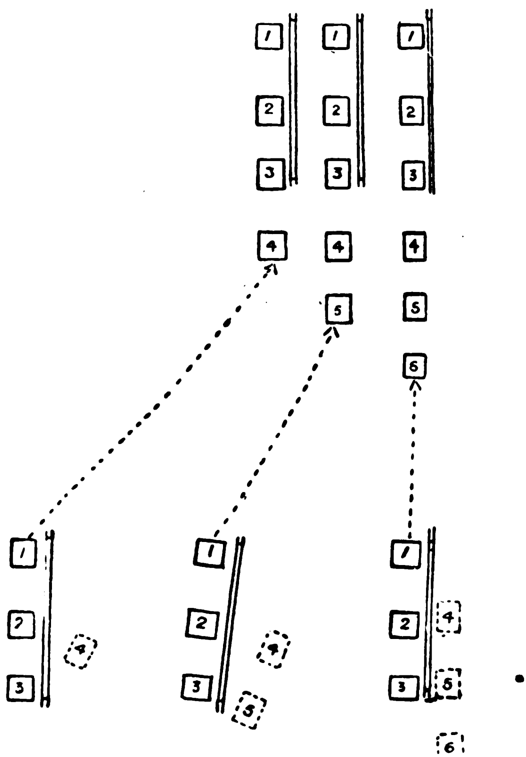


FIG. 38.—CLOSING FROM EXTENDED ORDER.

(Bearers on the right of stretchers dropping back into their original places.)

Exercises with Prepared Stretchers.*

125. Preparing Stretchers. Prepare—Stretchers.	The bearers on the right of the stretcher will take a side-pace to the right; Nos. 1 and 3 then turn to the right, kneel on the left knee, unbuckle the transverse straps and place the slings on the ground beside them, separate the poles and straighten the traverses; then each takes up a sling, doubles it on itself, slips the loop thus formed on the near handle, and places the free ends over the opposite handle, grip-plate uppermost.
(Two.)	On the word *Two,* they rise and turn to the left together, working by the right.
126. Closing Stretchers. Close—Stretchers.	Nos. 1 and 3 turn to the right, kneel on the left knee, remove the slings and place them on the ground beside them, push in the traverses, raise the canvas, and approximate the poles.
(Two.)	On the word *Two*, they rise, lifting the stretcher, and face one another; place the handles of the poles between their thighs, runners to the right, and roll the canvas tightl over the poles to the right.
(Three.)	On the word *Three,* each takes up a sling and passes the grip-plate† end to the other, and, holding the grip-plate end in the left hand, threads the transverse strap through the loop of the other sling and buckles it tightly close to the runner, keeping the sling on top. Then, grasping both handles in the right hand, back of the hand to the right, they turn to the right in a slightly stooping position, rise, and turn to the left together. The bearers on the right of the stretcher then take a side-pace to the left.

* The preparation of stretchers, and all movements with prepared stretchers, will be performed in extended order.

† The older pattern sling has a buckle instead of a grip-plate.

127. Lifting and Lowering Stretchers. LIFT—STRETCHERS.	On the word *Stretchers*, Nos. 1 and 3 stoop, grasp the doubled sling midway between the poles with the right hand and sweep it off the handles, rise, holding it at the full extent of the arm, grip-plate to the front.
(TWO.)	On the word *Two*, they take a side-pace between the handles and place the sling over the shoulders, dividing it equally, grip-plate to the right. The sling should lie well below the collar of the frock behind and in the hollow of the shoulders in front.
(THREE.)	On the word *Three*, stoop, slip the loops over the handles, commencing with the left, and grasp both handles firmly.
(FOUR.)	On the word *Four*, rise slowly together, lifting the stretcher, No. 3 conforming closely to the movements of No. 1.
ADJUST—SLINGS.	Nos. 2 turn about and step forward one pace; Nos. 4 turn to the left; they adjust the slings, taking care that they are well below the collar of the frock behind and in the hollow of the shoulders in front. The length of slings may be adjusted by means of the grip-plates if necessary.
(TWO.)	Nos. 2 turn about and step forward one pace; Nos. 4 turn to the right.
	Note.—This movement is required only when the Nos. 1 and 3 have not adjusted the slings correctly when lifting stretchers.

Lower—Stretchers.	Nos. 1 and 3 slowly stoop and place the stretchers gently on the ground, No. 3 conforming closely to the movements of No. 1; slip the loops from the handles, and stand up.
(Two.)	On the word *Two*, they remove the slings from the shoulders, hold them as before described, take a side-pace to the left, and stand to stretchers.
(Three.)	On the word *Three*, they stoop, place the slings on the handles as in "prepare stretchers," and rise together.
128. Changing Numbers. Change—Numbers.	The bearers on the right of the stretcher will turn about; the whole will step off together, No. 1 wheeling round by the front of the stretcher and taking up the position of No. 4. Each man halts in the position of the bearer whose place he has taken. The new numbers on the right of the stretcher will turn about.

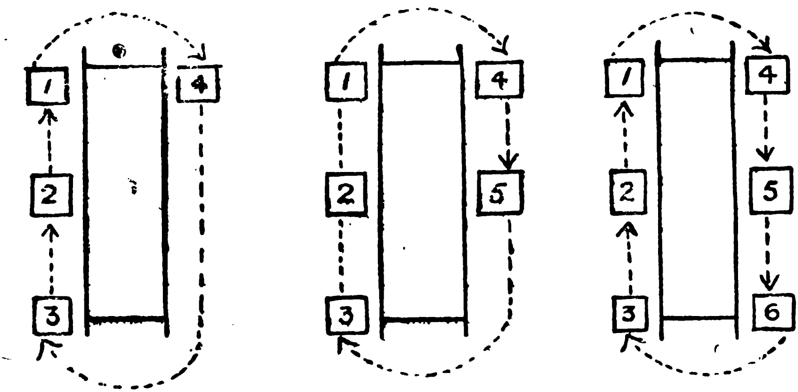


Fig. 39.—Changing Numbers.

(Bearers on the right of stretchers turn about.)

129. Advancing and Retiring. ADVANCE.*	The whole move off together, stepping short, No. 3 stepping off with the right foot, the remainder with the left, the Nos. 1 and 3 keeping their knees bent and raising the feet as little as possible. Special attention must be paid to the carriage of the stretcher so as to keep it level and avoid jolting or unnecessary swaying.
	Note.—The Instructor will see that the directing squad marches on a given point, taking the correct pace as regards length, and that the remainder preserve their interval.
RETIRE.	Each squad will move round by the right on the circumference of a circle of which No. 3 is the centre; Nos. 3 will mark time, turning gradually in the direction named, and the whole will move forward when square.
ADVANCE.	Each squad will resume the original direction to the front by a movement similar to that detailed for retiring.
130. Halting. HALT.	The whole will halt, care being taken not to jar or jolt the stretcher.
131. Inclining. RIGHT (OR LEFT) —INCLINE.	The Nos. 3 will mark time and turn gradually in the direction named, and the whole move forward when facing in the new direction.
	Note.—If the incline is repeated the squads will be in COLUMN OF SQUADS with an interval of one pace between each squad.

* When squads are ordered to advance, the directing squad or flank will be named.

132. Forming into line. (*See* Detail.)

To form into line, the command will be given :—*On the Right* (*or Left*), *Form—Line.* (*See* Detail for CHANGING DIRECTION, para. 122.)

133. Unloading and Loading Stretchers.

Notes.—Cadets, provided with ground sheets, to act as patients, will be placed in front of the squads, extended to four paces, and directed to lie down with their heads towards the squads.

When the bearers have sufficiently advanced in these exercises, the Nos. 4 will take charge of their respective squads.

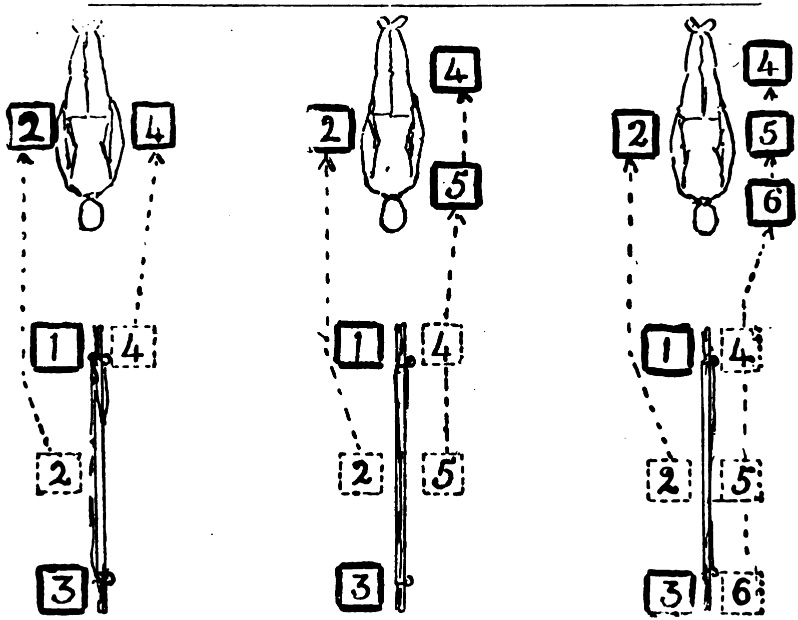


FIG. 40.—"COLLECT WOUNDED."

(The squads have advanced, halted, and lowered stretchers. While the stretchers are being prepared by Nos. 1 and 3, the disengaged bearers are rendering assistance to the patient.)

(1) *Loading.* COLLECT—WOUNDED.*	Each squad doubles by the shortest route to the corresponding patient, and halts without further word of command when one pace from the head of and in line with the patient.
	The No. 4 will proceed to the patient, examine and attend to his injury, and, if his carriage on the stretcher be necessary, he will give the following words of command :—
LOWER—STRETCHER. PREPARE—STRETCHER.	While the stretcher is being prepared by Nos. 1 and 3, the disengaged bearers will proceed to the patient to render such assistance as may be required, No. 2 going to the left, the remainder to the right, unless otherwise directed by No. 4.
LOAD—STRETCHER.	When the patient is ready for removal on the stretcher, No. 4 will give the command *Load—Stretcher*, when the bearers, unless otherwise directed by No. 4, will place themselves as follows :—Nos. 1, 2, and 3 on the left of the patient, the remainder on the right. No. 1 at the knees, No. 2 at the hips, No. 3 at the shoulders; the bearers on the right in corresponding positions. The whole, turning inwards together and kneeling on the left knee, will pass their hands beneath the patient. No. 1 supports the legs, No. 2 the thighs and hips, No. 3 the upper part of the trunk, the remaining bearers on the right assisting to lift the patient by passing their hands beneath in corresponding positions to Nos. 1, 2, and 3.

* The command *Collect Wounded* may be given when the squads are STANDING EASY, in which case they will come to ATTENTION, lift stretchers, and double out as above described.

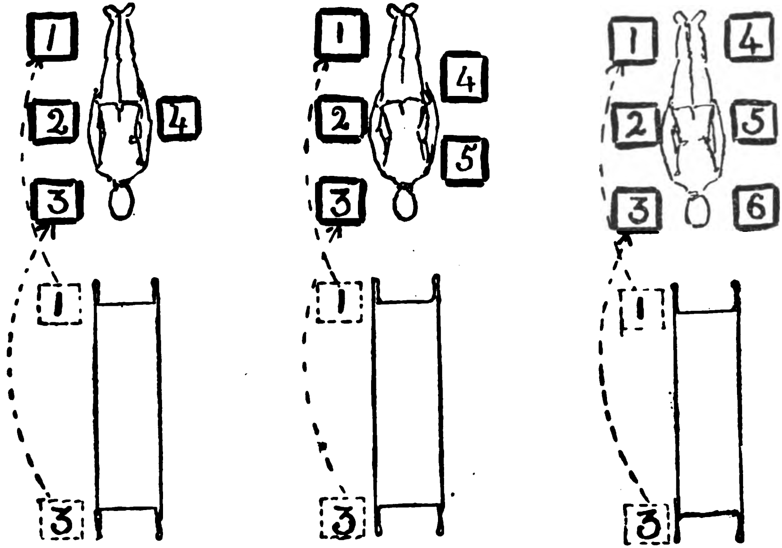


FIG. 41.—" LOAD STRETCHERS."
(The bearers in position ready to lift patient.)

	Note.—In lifting the patient off the ground, special care must be taken of the injured part, No. 4 giving the necessary instructions. In the case of a severe injury, No. 4 will himself attend to the injured part in lifting, directing another bearer to replace him if necessary.
LIFT.	The patient will be carefully lifted on to the knees of Nos. 1, 2, and 3. The bearers on the right of the patient then disengage, rise, and step back one pace; the bearer nearest the stretcher will turn to his left, double to the stretcher, take hold of it, left hand across, and rise,

		resting the near pole on the left hip, return to the patient and place the stretcher directly beneath him; then stand up and return to his former position. The bearers on the right of the patient will now step forward one pace, kneel on their left knees, and assist in lowering the patient when ordered by No. 4. (*See* Fig. 42.)

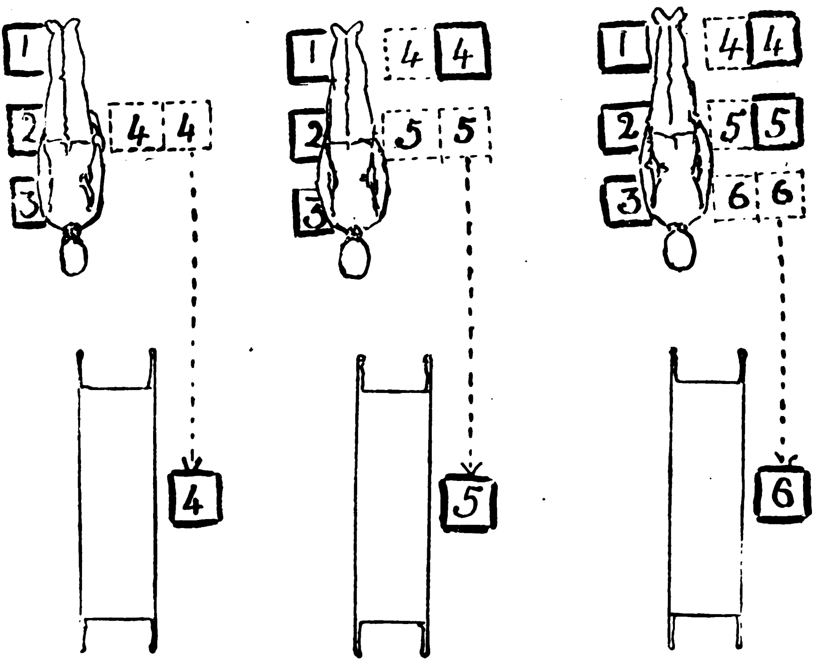


FIG. 42.—PATIENT ON KNEES OF NOS. 1, 2, AND 3 BEARERS.

(The bearer on right of patient who is nearest to the stretcher supplies the stretcher and places it on the ground beneath the patient.)

	Lower.	The patient is lowered slowly and gently on to the centre of the canvas, special care being taken of the injured part. The bearers then disengage, rise, Nos. 1, 2, and 3 turn to the left, the bearers on the right of the patient to the right, and stand to stretchers as in "prepared stretchers."

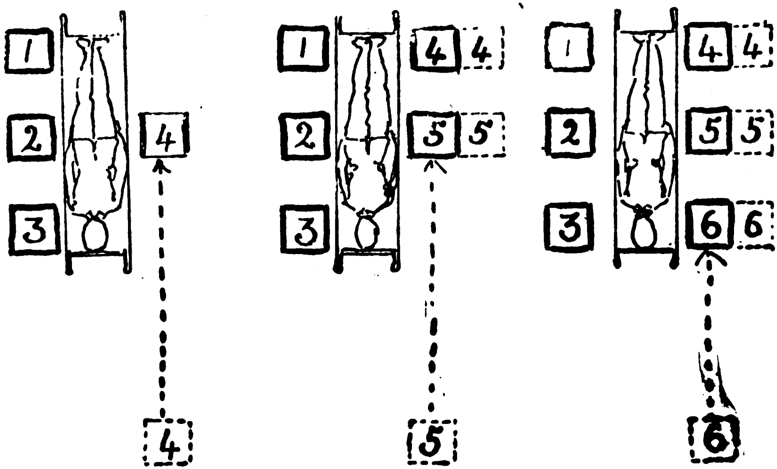


Fig. 43.—Lowering Patient on to Stretcher.
(The bearers on the right of patient step forward one paco to assist in lowering the patient on to the stretcher).

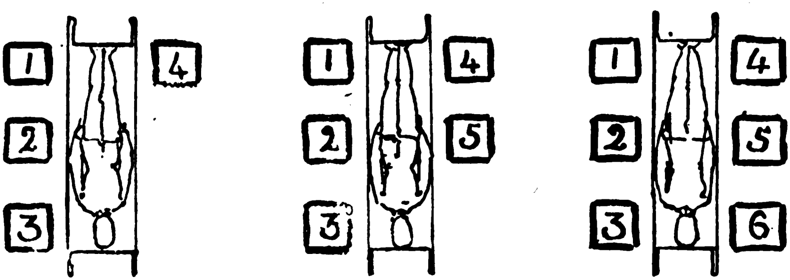


Fig. 44.—Patient on Stretcher.
(Patient on stretcher and bearers ready to move off.)

		The No. 2, 5, or 6 will collect the arms and equipment of the patient. The rifle should be examined by pointing it in the air, opening the breech, and detaching the magazine to ensure that it is unloaded.

Note.—Cadets under instructions should be exercised in carrying the loaded stretcher over various obtacles, and taught the methods most suitable for the safe carriage of the patients. When squads are acting independently they should be instructed to move at as wide an interval as possible with a view of minimizing the target for the enemy's fire, the disengaged bearers taking care not to become detached from the squad.

(2) *Unloading.*	When the stretcher is to be unloaded, the No. 4 will give the following words of command :—	
	UNLOAD—STRETCHER.	The bearers will place themselves as described for loading.
	LIFT.	The patient is lifted as described for loading. The bearers on the right of patient then disengage, rise, step back one pace ; No. 4 grasps the stretcher as described for loading, and, lifting it clear of the patient, carries it forward 3 paces clear of the patient's feet. He then rejoins his squad and with the other bearers steps forward and assists in lowering the patient to the ground.
	LOWER.	The patient is gently lowered to the ground ; the bearers disengage, rise, and turn towards the stretcher, the whole step off to their places at the stretcher as in prepared stretchers. (*See* Fig. 46.)

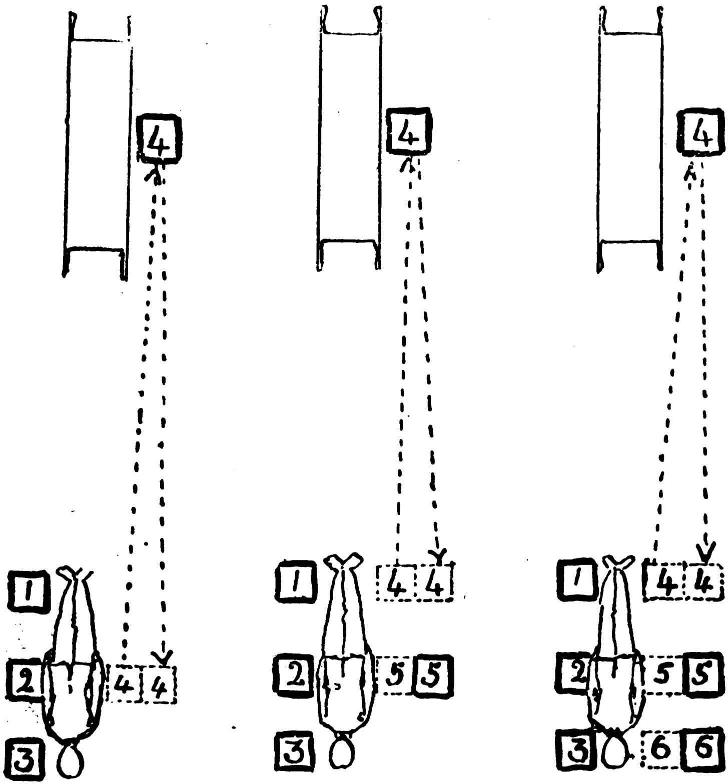


FIG. 45.—UNLOADING.

(No. 4 carrying the stretcher 3 paces clear of the patient's feet, and returning.)

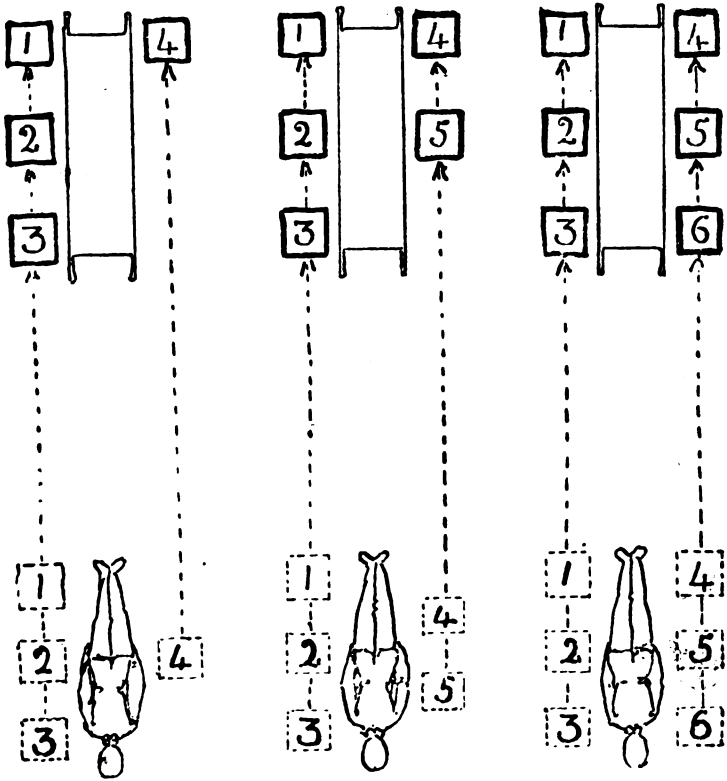


FIG. 46.—UNLOADING.

(Patient lowered to the ground and bearers taking up position at the stretcher as in prepared stretchers.)

Loading and Unloading Stretchers with reduced Numbers.

134. With Three Bearers.—In the event of there being only three bearers available, the stretcher will be placed at the patient's head, in the same line as his body. The bearers will then lift the patient, rise to the erect position, carry him head-foremost over the foot of the stretcher, the horizontal position of his body being maintained throughout the movement, and lay him in a suitable position on the canvas. When unloading, the patient will be lifted and carried head-foremost over the head of the stretcher. To lift the patient, one bearer, placing himself on the injured side in a line with the patient's knees, raises and supports the lower limbs, while the other two, kneeling on opposite sides of the patient, near his hips, facing each other, each pass an arm under his back and thighs, lock their fingers so as to secure a firm grip and raise and support the trunk.

135. With Two Bearers.—When only two bearers are available, the stretcher will similarly be placed at the patient's head, and in the same line as his body. The bearers will then lift the patient, rise to an erect position, carry him, in loading, head-foremost over the foot of the stretcher, and, in unloading, head-foremost over the head-end.

The method of lifting will vary according to whether the lower limbs are severely injured or not :—

(*a*) With a severe injury of one of the lower limbs, both bearers place themselves on the injured side ; the one in a line with the patient's knees must raise and support the lower limbs, the one near the patient's hips, the body, assisted by the patient himself as far as possible, the horizontal position of the patient's body being maintained throughout the movement.

(*b*) With the lower limbs intact or only slightly injured, the patient may be lifted by the improvized seat described in the next chapter, provided there are no symptoms of shock present ; in the latter case, method (*a*) must be resorted to.

AMBULANCE WAGON EXERCISES.

136. For instructional purposes the squads will be numbered by fours.

The ambulance wagons will be drawn up in single rank on the drill ground. A corporal or private will be told off as wagon

orderly to each wagon. They will lower the seats and rails of the upper compartments and prepare the wagons for the reception of the wounded.

137. Loading Wagons. ON WAGONS—RETIRE.	The stretcher squads retire towards the line of wagons; the four squads on the left, as the line is retiring, proceeding to the wagon on the extreme left, the next four squads to the next wagon, and so on to the right of the line, closing in to two paces interval between the squads, and halting without further word of command when four paces from the tail board of the wagon.
LOWER—STRETCHERS.	As before detailed.
FIX—SLINGS.	Slings will be fixed as follows:—Nos. 1 and 3 turn to the right, kneel on the left knee, pass the loop of the grip-plate end over the near handle, grip-plate downwards, carry the sling under and round the opposite handle close up to the canvas, back to the near handle, round which two or three turns are made, pass the transverse strap round the pole between the runners and traverse, and fasten the buckle outside the sling between the poles; the bearers then rise and stand to stretchers. While this is being done, the patient's rifle and kit will be stored in the wagon, and the bearers will take up position as follows:—Nos. 1 and 3 on the left, 2 and 4 on the right of the stretcher, No. 2 placing himself opposite No. 3; the remaining bearers taking a side-pace of 30 inches to the right. (*See* Fig. 47.)
	Note.—When the bearers have learned to fix slings, the order *Lower Stretchers and Fix Slings* will be given as one order by No. 4 and carried out accordingly.
STAND—EASY.	As in Infantry Training.

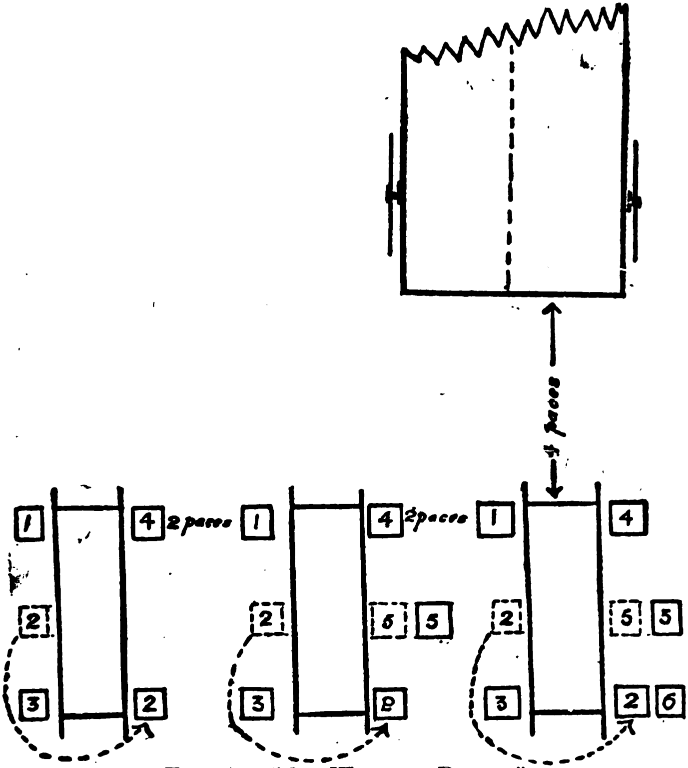


FIG. 47.—"ON WAGONS—RETIRE."
(Three squads of four, five, and six bearers in position ready for loading wagon.)

SQUADS, IN SUCCESSION FROM THE RIGHT,—LOAD.

When the squads are sufficiently advanced in these exercises, the Nos. 4 will take charge of their respective squads and give the following words of command :—

Note.—The upper compartments will be loaded first, commencing with the off-side.

	No.—SQUAD, ATTENTION. LOAD—WAGONS.	The Nos. 1, 2, 3, and 4 bearers turn inwards, stoop, grasp the poles of the stretcher, hands wide apart, palms uppermost; the remaining bearers stand fast. Then, working together, they rise slowly lifting the stretcher, holding it level at the full extent of the arms.

	ADVANCE.	On the command *Advance*, they advance towards the wagon with a side-step crossing their feet in front, the first step being taken with the foot nearest the wagon ; they halt one pace from the tail-board of the wagon, and, lifting the stretcher on a level with the floor of the upper compartment, place the front runners on it, Nos. 2 and 3 slightly raising the head of the stretcher. The stretcher is then gently pushed into its place, Nos. 1 and 4 making way for the stretcher to pass between them. When loading the upper compartment the stretcher is gently pushed into the wagon until the handles at the head end are in line with the tail-board ; Nos. 1 and 3 then enter the wagon, No. 1 going to the foot, No. 3 to the head-end of the stretcher, and gently push it into its place and secure it there by means of the strap.
	FALL—IN.	As soon as the stretcher is in its place, the No. 4 will give the command *Fall—in*, when the bearers will fall in, as in file, facing the wagon.
	RE-FORM SQUAD, QUICK—MARCH.	The bearers will wheel round to the right and re-form squad, as in file, facing the field, four paces behind and to the right of the remaining squads. (*See* Fig. 49.)
	HALT, STAND—EASY.	As in Infantry Training.

Notes.—When loading the upper compartment, it may be necessary for the No. 1 to enter the wagon as soon as disengaged, and guide the front runners over the rubber blocks which retain the stretcher in position in the wagon. As soon as the off upper compartment is loaded, the next squad will be ordered to load the near upper compartment. As soon as this is completed the lower compartments will be loaded in the same way. When loading the lower compartment it will not be necessary for Nos. 1 and 3 to enter the wagon.

When the wagon is fully loaded the upper seats will be securely strapped to the side of the wagon by the wagon orderly, and the tail-board lifted and secured in its place.

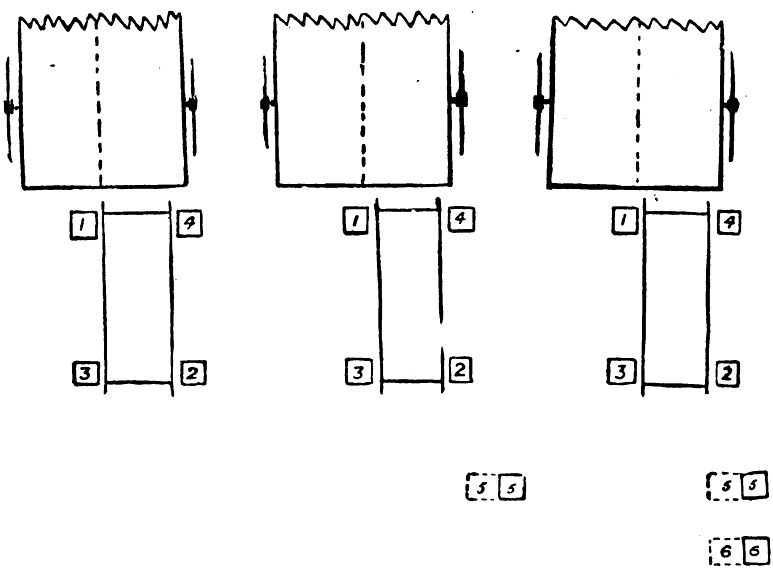


FIG. 48.—"LOAD WAGONS."

(Squads advanced towards the wagons to load.)

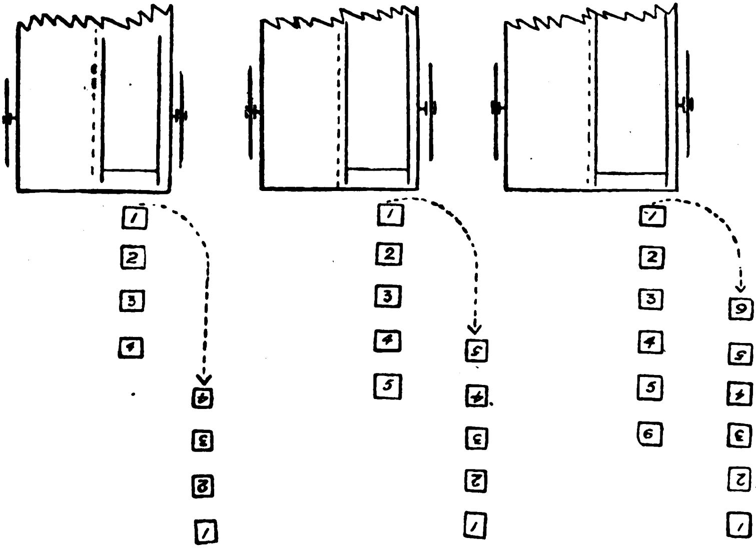


FIG. 49.—RE-FORMING SQUAD.

(Facing the field.)

138. Unloading Wagons.	*Notes.*—The requisite number of squads will be drawn up ten paces from and facing the tail-boards of the wagons. The squads will be numbered by fours.
SQUADS, STAND—EASY.	As in Infantry Training. The wagon orderlies will prepare the wagons as for loading. The lower compartments will be unloaded first, commencing with the off compartment.

SQUADS, IN SUCCESSION FROM THE RIGHT,— UNLOAD.	When the squads are sufficiently advanced in these exercises, Nos. 4 will take charge of their respective squads and give the following words of command :—	
	NO.—SQUAD, ATTEN- — TION. FOR UNLOADING, TAKE— POST.	The squad moves off towards the wagon, Nos. 1, 2, and 3 stepping short to allow the remaining bearers to come up on their right ; the whole will then move forward in quick time, halting without further word of command one pace from the tail-board of the wagon. (*See* Fig. 50.)
	UNLOAD— WAGONS.	The bearers on the right will take a side-pace of 30 inches to their right ; Nos. 2 and 3 pass up between Nos. 1 and 4 (No. 2 going to the right), lay hold of the handles, and, raising the head of the stretcher about 6 inches, gently withdraw it. As the stretcher is withdrawn, Nos. 1 and 4 take hold of the handles at the foot-end, and, taking the weight, lower it to the full extent of the arms, great care being taken to keep the stretcher level and to avoid jarring the patient as the stretcher leaves the compartment.
	RETIRE.	The squad will retire and place the stretcher on the ground selected for the purpose ; then stand to stretchers, being joined by Nos. 5 and 6 with the patient's rifle and kit. If there are only four bearers to the squad, No. 2 will return to the wagon for the patient's kit, &c.
	STAND— EASY.	As in Infantry Training.

Note.—In unloading the upper compartment Nos. 1 and 3 enter the wagon as in LOADING, withdraw the stretcher until the handles at the head-end are in line with the tail-board of the wagon, then rejoin their squad ; the stretcher is withdrawn as in previous detail.

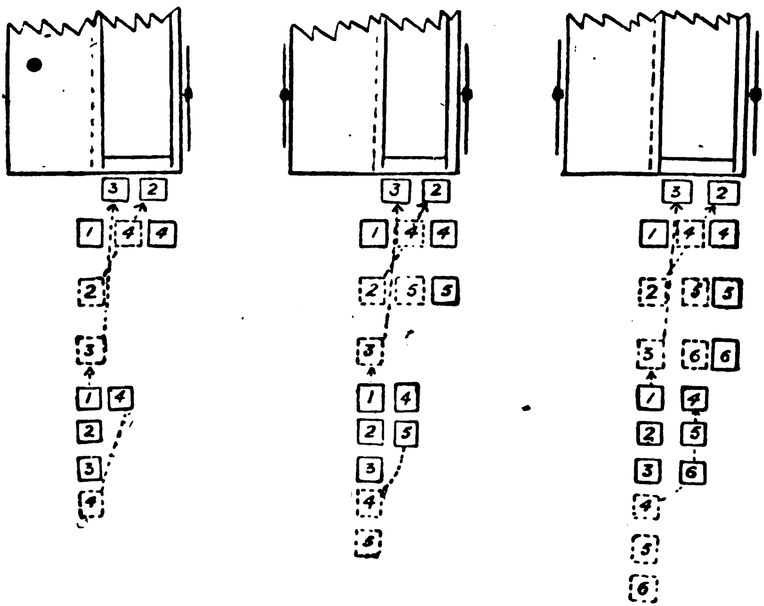


FIG. 50.—UNLOADING WAGONS.

(Squads taking posts and unloading.)

HAND-SEAT EXERCISE.

THE "HOOK-GRIP" SEAT.

139. The bearers will be formed up in double-rank and numbered :—

Odd Numbers : Right Files.
Even Numbers : Left Files.

FORM TWO-HANDED—SEATS.	The right files turn to the left, the left files to the right.

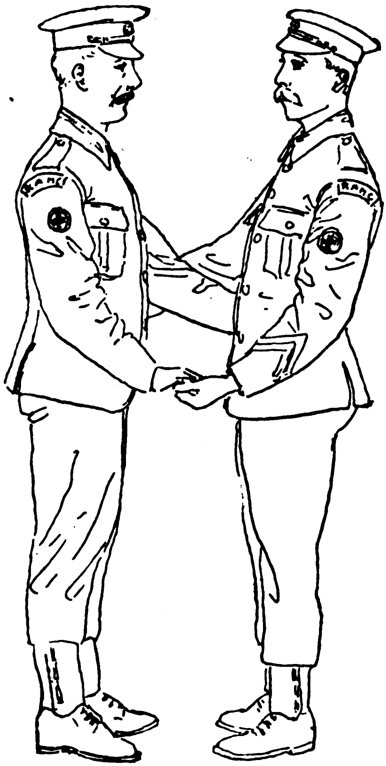


FIG. 15.—THE "HOOK-GRIP" SEAT.

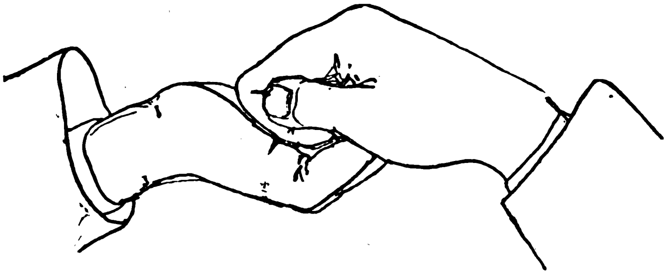


FIG. 52.—METHOD OF FORMING "HOOK-GRIP."

(Two.)	The right files bend the fingers of the right hand at the second joint, back of the hand uppermost. The left files bend the fingers of the left hand at the second joint, back of the hand downwards. The right and left files hook the hands together, each placing the disengaged hand upon the other's hip. (*See* Figs. 51 and 52.)
FILES, RIGHT AND LEFT—TURN.	The files resume the position of ATTENTION, and turn in the original direction.

CHAPTER II.

FIELD COOKING.

140. To cook rapidly and well is an art not difficult to acquire, and one which cadets should be encouraged to learn. The means generally used for cooking in the field are camp-kettles and the mess-tin, the lid of which can be used as a frying-pan. Troops should, in all circumstances, have their dinners ready an hour and a half after the rations are issued.

141. Messes should be by kettles, that is, the number of cadets composing a mess should depend on the kettle used. Full instructions with regard to this, as well as with regard to cooking in mess-tins, preserved meat tins, &c., and the improvization of field ovens, are given in the Manual of Military Cooking, together with useful recipes for cooking in the field.

142. Field Kitchens.—On a unit's arrival in camp the cooks will at once proceed to make the kitchen. This can either be a trench-kitchen or one without a trench.

The Trench Kitchen.—If the encampment is only for one night, one or two trenches, according to the number to cook for, should be

dug 7 feet 6 inches long, 9 inches wide, and 18 inches deep at the mouth, and continued for 18 inches into the trench, then sloping upwards to 4 inches at the back, with a splay mouth pointing towards the wind, and a rough chimney 2 feet high at the opposite end formed with the sods cut off from the top of the trench. If the upper 6 inches of the edge of the mouth are bevelled off, air is more freely admitted to the trench. It will be advantageous if these trenches are cut on a gentle slope. This trench will hold seven of the large oval kettles.

Iron cooking bars are placed across the trench to support the kettles. The kettles are placed side-by-side with their bottoms resting on the ridges of the trench. The spaces between them are packed with wet earth or clay, which should reach as high as the

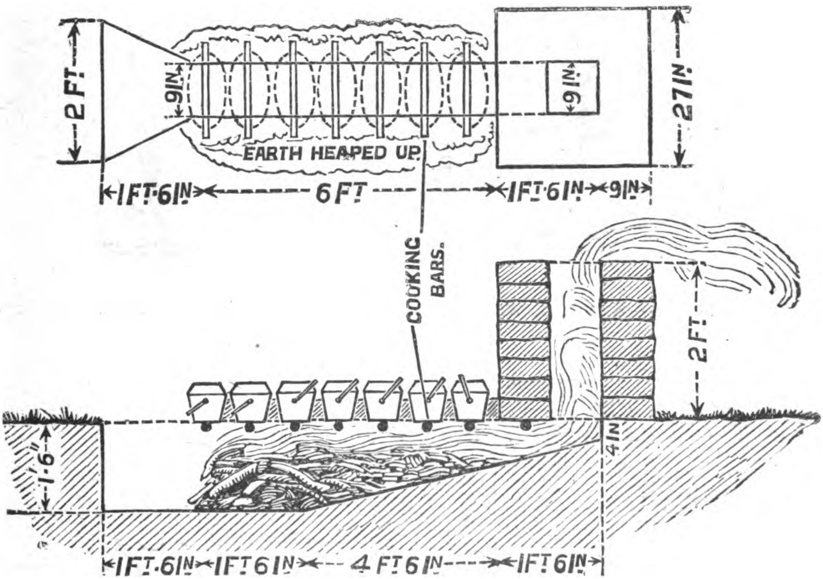


FIG. 53.—PLAN AND SECTIONAL ELEVATION OF TRENCH-KITCHEN WITH CAMP-KETTLES, TO SHOW DIMENSIONS AND DETAIL.

loops of the handles. The fuel, generally wood, is fed into the trench from the splay mouth. (*See* Fig. 53.)

Without a Trench.—The simplest and best arrangements for cooking in the field for any party over twenty, if the stay in camp is for a night only, is to place a proportion of the kettles on the ground in two parallel rows about 9 inches apart, handles outwards; block the leeward end of the channel so formed with another kettle, lay the fire, and place over it one or two rows of

kettles resting on those already placed in position. (See Figs. 54 and 55.)

Fig. 54.—Kitchen, without a Trench with Camp-kettles.

Fig. 55.—Field Kitchen without a Trench.

143. Improvized Field Oven.—Given an empty kerosene oil tin and a few bricks or stones, a very simple form of improvized oven for a small party can be made on the lines indicated below. The following materials are required to construct the oven :—An empty kerosene oil tin with the top removed, two pieces of iron (hoop-iron if obtainable) for the tin to rest upon, and some bricks or stones; using mud or clay to cement the stones together. Build the base to form a cross as shown in Fig. 56; on this place the bars and the tin lying on its side, and proceed to build up the stones and mud round the tin, at the same time forming the side and back flues as shown in Figs. 57 and 58. The top is built, as in Fig. 56, to form a cross-flue, the chimney being formed by means of an empty coffee tin or a piece of rolled tin. The opening to the oven can be closed with the top cut from the kerosene oil tin, and made tight with clay, or a stone may be used for the same purpose. The whole of the exterior should be covered with watery clay, or mud, as often as is necessary. The fire should be lighted under the tin, wood being used as fuel.

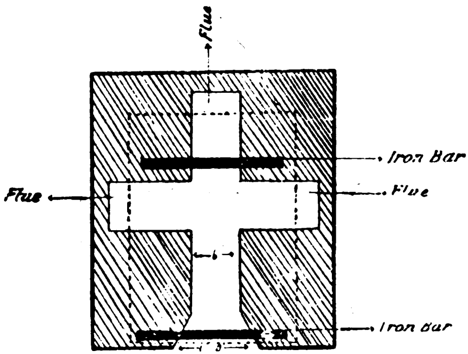


Fig. 56.—Plan.
Dotted lines indicate tin in position.

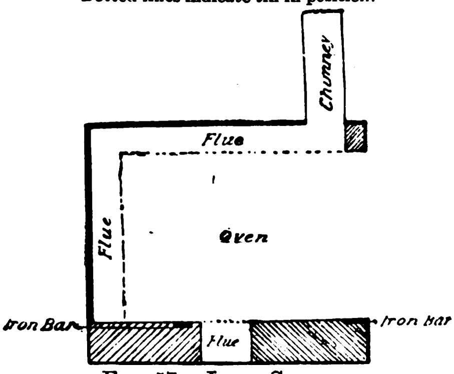


Fig. 57.—Long Section.
(Shaded parts indicate brick or stone.)

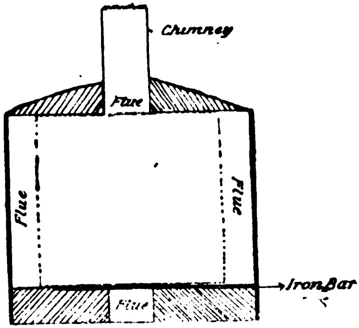


FIG. 58.—CROSS SECTION.

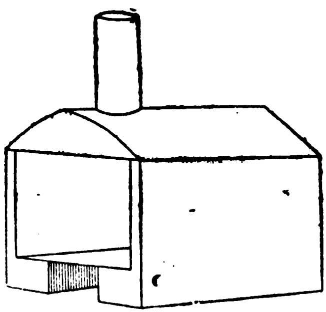


FIG. 59.—ELEVATION.

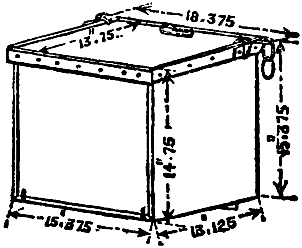
FIGS. 56-59.—IMPROVIZED FIELD OVEN.

144. The Portable Stove.—This stove (Fig. 60) is for use in medical units in the field. It consists of two ovens, two boilers with lids, four baking-dishes, one grate, and two shelves. The ovens (one of which is smaller than the other) are made of steel-plate. The grate is made of wrought-iron, and the boilers and baking-dishes of tin-plate. Each apparatus is considered capable of cooking for 50 patients.

To put the stove together for use, place the ovens back-to-back leaving space between them to receive the grate, which is provided with four hooks to engage in slots in angle-pieces fixed to the bottoms of the ovens. Before the grate is set in its place, connect the ovens together by means of the plates pivoting on the sides of the smaller oven and furnished with hooks to fit into slots cut in the top of the larger oven. These plates, when in position, close in the fire-place. The doors of the oven have their hinges at the

top, and open upwards. Each oven has a movable shelf of plate-iron to rest on a ledge and intended to receive one baking-dish, the second being placed on the bottom of the oven. The boilers rest on top of the ovens over the fire.

PACKED.



READY FOR USE.

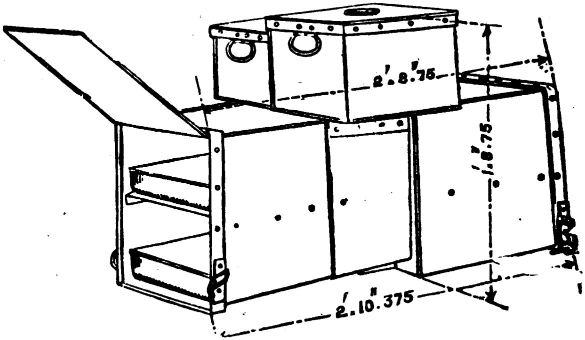
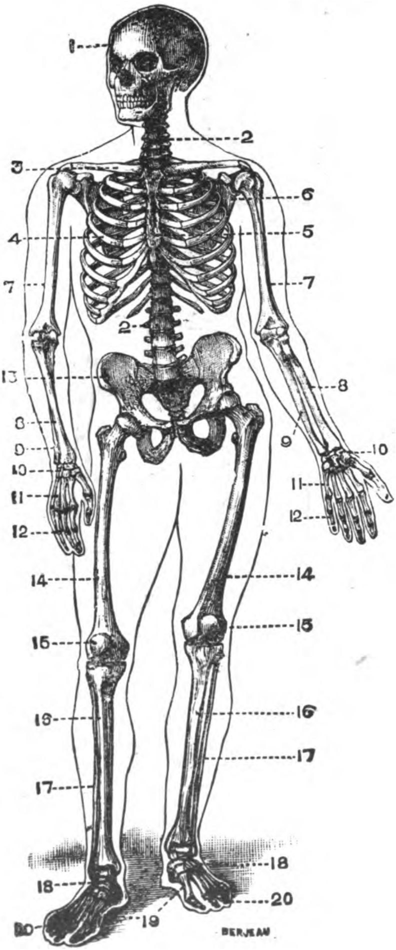


FIG. 60.—PORTABLE STOVE.

To pack the stove for transport, place the small oven inside the large one, with the large shelf on its top, and the small shelf at one side of it. Put the small boiler into the large one, and place the latter with the baking-dishes inside the small oven. Place the grate in last, resting on the boiler. In packing the grate, place the bottom bars, not the hooks, next the boiler, or the latter will be injured.

PART III.

Training of the Cadets in First Aid, and Nursing.



1. Cranium, or skull.
2. Spine formed of vertebræ.
3. Clavicle, or collar-bone.
4. Ribs.
5. Sternum, or breast-bone.
6. Scapula, or shoulder-blade.
7. Humerus, or arm-bone.
8. Radius.
9. Ulna.
10. Carpus, or wrist-bones.
11. Metacarpal bones.
12. Phalanges, or finger-bones.
13. Pelvis.
14. Femur, or thigh-bone.
15. Patella, or knee-cap.
16. Tibia, or shin-bone.
17. Fibula.
18. Tarsus, or ankle-bones.
19. Metatarsal bones.
20. Phalanges, or toe-bones.

FIG. 61.—THE SKELETON.

CHAPTER I.

ANATOMICAL AND PHYSIOLOGICAL OUTLINES.

145. Construction of the human body.—The human body is made up of :—(1) The skeleton or bony framework with its joints; (2) the Muscles, which make every movement; and (3) the Nervous System, which receives impressions and governs all these movements. Further, as every movement of the body causes waste, some means are required for removing the products of waste and for supplying nourishment to make up for it. The following are concerned in supplying such needs, viz., (4) the Circulatory System—heart, blood and blood-vessels—to carry to different parts of the body nourishment and oxygen; (5) the Respiratory System—lungs and air-passages—to take in air and so give oxygen to the blood; (6) the Digestive System—mouth, stomach and intestines, and certain glands—to take in and give to the system food and water; (7) the Excretory System—kidneys, lungs, and skin—to extract from the blood the products of waste and to eliminate them; and (8) the Skin, enclosing the whole, for the protection of the body and the regulation of its heat.

THE BONES, JOINTS AND MUSCLES.

146. The Skeleton.—The skeleton consists of a number of bones, some long, some short and irregular, held together by bands or ligaments to form joints, which allow of greater or less movement between them. The bones determine the general shape and proportions of the body, give attachment to the muscles, and form levers on which the muscles act to move the body or limbs from one position to another. They also form cavities for the protection of important organs.

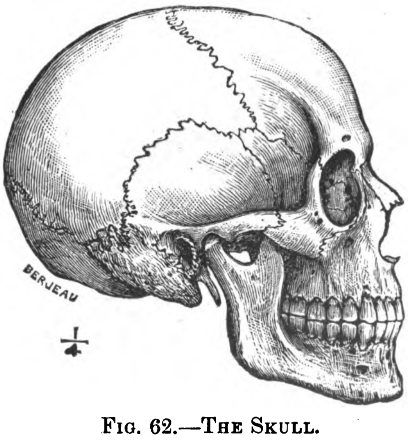


FIG. 62.—THE SKULL.

147. The Skull.—The bones of the head and face are together called the skull. The skull consists of two portions, namely, the cranium, a strong bony case for the protection of the brain, and the face, which consists of a number of bones, of which one only, the lower jaw, is movable.

148. Bones of the Trunk.—The bony parts of the trunk are the spinal or vertebral column, the chest or thorax and the pelvis formed by the two large hip-bones and the sacrum.

The spinal column or backbone may be said to consist of thirty-three bones, but only twenty-four of these are movable. These are called vertebræ (see paras. 177 and 178). Through the centre of this column runs a canal or cavity, the spinal canal, which contains and protects the spinal cord. The spinal canal ends in the sacrum.

The chest or thorax is a large bony cavity formed by the union of the twelve dorsal vertebræ with the ribs, and the breast-bone or sternum in front, containing the heart, lungs, œsophagus or gullet, and the great blood-vessels.

The ribs or costæ are twenty-four in number, twelve on each side, connected in pairs with the dorsal vertebræ behind, and, with the exception of the last two pairs, with the sternum or breast-bone in front. Each of these pairs of ribs forms a circular arch called the costal arch.

The sternum is a long, flat, soft bone, the lower portion of which is composed of flexible cartilage.

The first seven pairs of ribs are called the true ribs, and have their own costal cartilage connecting them directly with the sternum. The next three pairs are each connected with the cartilage next above it, so that they are united to each other before they reach the sternum. The remaining two pairs are not connected in any way with the breast-bone. The last five pairs are termed false ribs; and of these the last two pairs are called free or floating ribs.

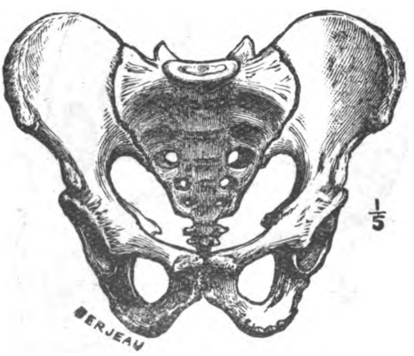


FIG. 63.—THE PELVIS.

The sacrum, and the innominate or nameless bones, one on either side, are firmly united to form the basin-shaped cavity of the pelvis, which contains and protects the bladder and the lower end of the bowel or rectum, and to it the lower extremities or limbs are attached.

149. Bones of the Upper Limb.—The upper limb is divided into the shoulder, the arm, the forearm and the hand.

The shoulder connects the arm to the trunk, and includes two bones: the collar-bone or clavicle and the shoulder-blade or scapula. The former is a long, curved bone situated in front at the bottom of the neck and connecting the shoulder-blade to the breast-bone, whilst the latter is a large, flat, triangular bone lying upon the ribs behind.

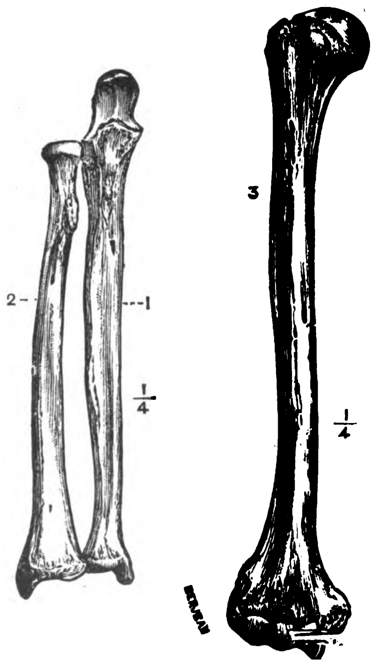
FIG. 64.—THE RIGHT COLLAR-BONE (seen from above).

The bone of the arm is called the humerus; it is a long bone, having at its upper end a rounded head, which works in a socket in the scapula or shoulder-blade, and at its lower end a roller-shaped surface, which, with the bones of the forearm, forms the elbow-joint.

FIG. 65.—THE RIGHT SHOULDER-BLADE (seen from behind).

The bones of the forearm are the radius and the ulna. The radius extends from the outer side of the elbow to the thumb-side of the wrist. The ulna extends from the inner side of the elbow to the little finger side of the wrist. At its upper end is a projection, called the olecranon, which forms the point of the elbow. There is a space between the radius and ulna.

The bones of the hand are arranged in three rows: firstly, in the wrist or carpus are eight small bones, called the carpal bone; secondly, a row of five long bones, called the metacarpus, forming the palm; and lastly, small bones, named the phalanges, three for each finger and two for the thumb.



1. Ulna.
2. Radius
3. Humerus.

Fig. 66.—Bones of the Right Arm and Forearm.

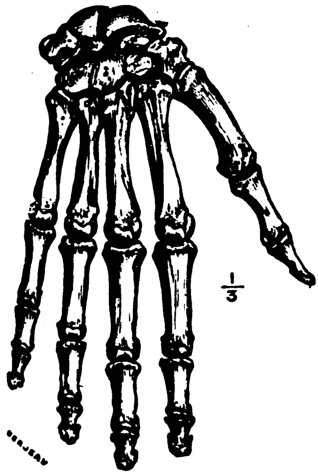


FIG. 67.—THE BONES OF THE RIGHT HAND.

150. Bones of the Lower Limb.—The lower limb is divided into the thigh, the leg and the foot.

The thigh is that portion which extends from the hip above to the knee below ; its one bone is named the femur or thigh-bone, and is the largest and strongest in the body. At its upper end there is a rounded head, which fits into a deep, cup-shaped depression in the innominate bone forming the hip-joint ; below, the expanded end of the bone enters into the formation of the knee-joint. Protecting the knee-joint in front there is a small bone called the patella or knee-cap.

The leg, extending from the knee to the ankle, has two bones, a larger one lying on the inner or great-toe side, called the tibia or shin-bone, upon the flat expanded head of which rests the lower end of the thigh-bone, and a more slender one on the outer side, called the fibula.

The construction of the foot is like that of the hand ; it has three rows of bones ; the hinder part, or tarsus, is formed of seven short strong bones, called the tarsal bones ; secondly, a row of five longer bones, the metatarsus, corresponding to the sole of the foot and instep ; lastly, small bones, named the phalanges, three for each of the four outer toes and two for the great toe.

151. Joints and Ligaments.—A joint or articulation is the place where two or more bones work on each other. The ends of

the bones where they touch one another are covered with a smooth, glistening material called cartilage, and they are kept together by bands which allow the bones to move in certain directions, but are

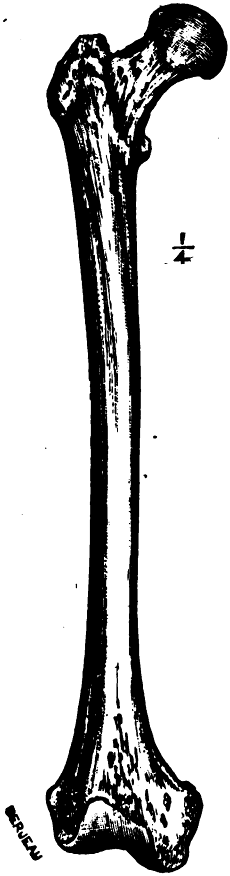


FIG. 68.—THE RIGHT THIGH-BONE (right side).

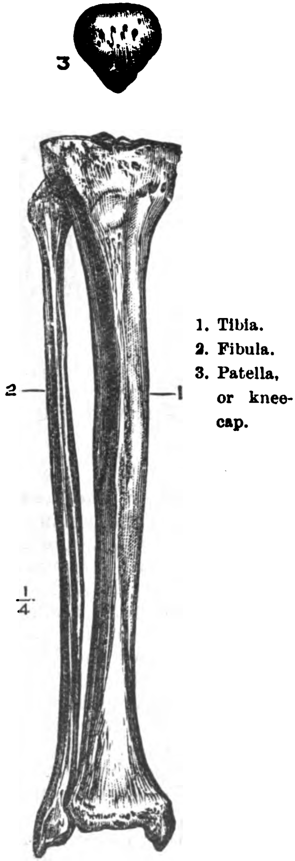


FIG. 69.—THE BONES OF THE RIGHT LEG (right side).

tight in certain positions, so as to prevent the bones from slipping out of place. These bands are called ligaments. From the inside of the joint an oily material, like the white of a raw egg, and called

synovia, is poured out, which allows the ends of the bones to glide smoothly over one another. The membrane which lines the joint and provides this material is called the synovial membrane.

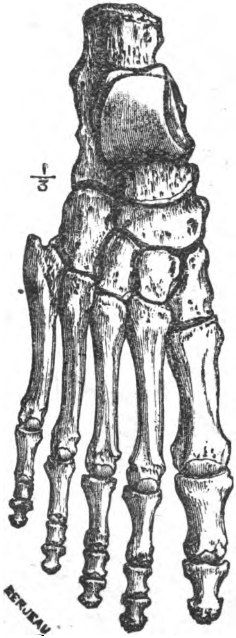


FIG. 70.—THE BONES OF THE RIGHT FOOT.

The two principal kinds of joints are the ball-and-socket and the hinge-joint. The ball-and-socket joint allows one of the bones to move freely in all directions. The shoulder and hip are joints of this description, the scapula and the innominate bone each having a cup-like hollow, into which fit the rounded, ball-shaped ends of the long bones of the arm and thigh. The second kind of joint, working like the hinge of a door, allows of movement up and down, or backwards and forwards only, as seen in the elbow and knee.

152. Muscles.—The muscles form the red flesh of the body, and are arranged in bands. These bands pass from one bone to another and are attached to the bones, very commonly by means of leaders or tendons. These muscles have the power of contracting or shortening themselves under the influence of the will, and so of moving the bones to which they are attached. In this manner the limbs and different parts of the body are made to move.

The Organs of Circulation.

153. The organs of circulation consist of the heart and blood-vessels, and contain the blood. They are the means by which the nourishment and oxygen are carried round the body, and waste matters conveyed to places where they are to be got rid of.

154. The blood is a fluid of a red colour, which coagulates or changes into a jelly-like mass or clot when it escapes from the blood-vessels. It is made up of two parts : a clear fluid called the liquor sanguinis, which is what is seen in a blister ; and many millions of very minute, coin-shaped bodies which give to the blood its colour and substance, and which collect together in the blood-clot. These little discs are too small to be seen by the naked eye : over 3,000 placed in a line side-by-side would not make up 1 inch. They are called corpuscles. The blood in the right side of the heart and in the veins of the body is dark-coloured, and requires aeration, *i.e.*, to be supplied with oxygen from the air ; that in the left side of the heart and the arteries of the body is bright scarlet, and is

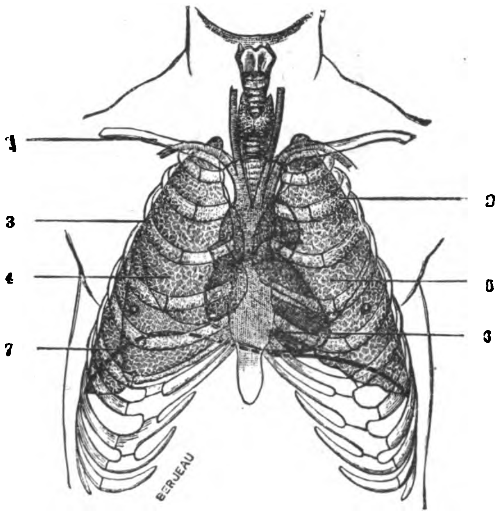


Fig. 71.—The Thorax or Chest.

1. Collar-bone. 2. Second rib. 3. Third rib. 4. Right lung. 5. Left lung. 6. Heart. 7. Cut edge of diaphragm.

aerated, *i.e.*, it has obtained oxygen from the air during its passage through the lungs. The dark-coloured blood is called venous blood, the bright-coloured blood is called arterial blood.

155. The heart is a hollow, muscular pump about the size of a closed fist, lying in the middle of the chest between the two lungs, with its point or apex towards the left side.

It is divided into a right and left half, separated by a partition, so that nothing can pass directly from the right to the left side of the heart. Each half is divided by another partition into an upper, thin-walled receiving-chamber and a lower, thick-walled pumping-chamber. The upper chamber is called an auricle, the lower a ventricle. There is a flap or valve between each auricle and ventricle, which allows the blood to pass in one direction only, namely, from the auricle to the ventricle. These chambers of the heart contract between 70 and 80 times in a-minute, and so force the blood into the arteries, which will be presently described, and through them into the most remote parts of the body. The blood is returned to the heart by means of the veins. A continuous circulation is thus kept up.

156. The blood-vessels are tubes extending from the heart to every part of the body, and which, with the heart, contain the blood.

There are three kinds of blood-vessels, viz., arteries, capillaries, and veins. The blood passes along these tubes, which open into one another, and does not escape from them.

Arteries are thick-walled, strong tubes, leading from the pumping chambers of the heart (the ventricles), branching and getting smaller as they proceed, and dividing into very small vessels with very thin walls, which are so small as to be invisible to the eye. These are called capillaries.

The walls of the capillaries are so thin that the dissolved nourishment which comes from the digestive system, and the oxygen which comes from the lungs and is contained in the blood, can pass through them into the tissues of the body and so nourish it; while impurities from the tissues soak into them and are carried by the blood into the veins. The capillaries form a close network all over the body, and gradually collecting together and getting larger, they become veins.

The veins, thin-walled tubes, commencing thus in the capillaries, become fewer in number and larger in size as they get nearer the heart, until they end in the large veins which open into its upper chambers (the auricles).

The arteries carry the blood from the heart to the capillaries, the veins from the capillaries to the heart. The blood travels rapidly in the arteries and veins, and very slowly in the capillaries, so as to allow the work above described to be done.

157. Circulation.—In the body there is a double circulation, owing to the fact that the oxygen required to aerate the blood cannot be taken into the blood at the same time as nourishment. Consequently, the blood has to make one round to take in nourishment and to distribute nourishment and oxygen, and a second round through the lungs to take in the oxygen from the air which is drawn into them. Of these two rounds or circulations, the first is called systemic, the second pulmonary. The systemic circulation

is that of every part of the body except the lungs. The pulmonary circulation takes place in the lungs alone, and is for the sole purpose of aerating the blood. The pulmonary veins are the only veins in the body containing bright-coloured blood, and the pulmonary arteries the only arteries in the body containing dark-coloured blood. The blood, when it passes from the capillaries of the lungs, is aerated and bright scarlet; it remains so while it circulates through the veins of the lungs into the left auricle, from thence into the left ventricle, from thence into the systemic arteries, until it passes into the systemic capillaries, where it loses the oxygen with which it has been charged and becomes dark-coloured. It remains dark-coloured while flowing from the systemic capillaries into the systemic veins, from thence into the right auricle, right ventricle, thence into the arteries of the lungs, and from thence into the capillaries of the lungs, where aeration again takes place and the bright-red colour is restored. This is the course of the circulation. The blood in the systemic capillaries takes up nourishment from the stomach and bowels.

The pumping action of the heart produces a wave through the arteries, which can be felt where they come near the surface of the body, as at the wrist just above the root of the thumb. This wave or beat is called the pulse, each beat corresponding with the contraction or beat of the heart.

In the veins there is no beat or pulse, the force of the blood-current having been expended while passing through the wide network of capillaries lying between the ends of the arteries and the commencement of the veins, so that the blood flows in the latter in a steady, even stream.

The Organs of Respiration.

158. The organs of respiration or breathing are the means by which air is taken into the lungs, and one of its gases, called oxygen, is given to the blood. While the oxygen is being taken into the blood, carbonic acid gas, certain other gases, and watery vapour pass from the blood into the air in the lungs, and are breathed out.

The organs of respiration consist of the trachea or windpipe and the lungs.

The trachea is a stout tube through which the air passes into and out of the lungs. Its upper part, called the larynx, is the organ of voice, and opens into the back of the mouth and nose. The windpipe can be felt in the throat under the skin where it lies immediately in front of the gullet. In the chest it divides into two tubes, the bronchi, one for each lung.

There is a flap, called the epiglottis, at the upper opening of the larynx, which covers it, and prevents food from passing into the windpipe when swallowing.

The bronchi are stout tubes leading from the windpipe to the lungs. In the lungs the bronchi branch out in all directions,

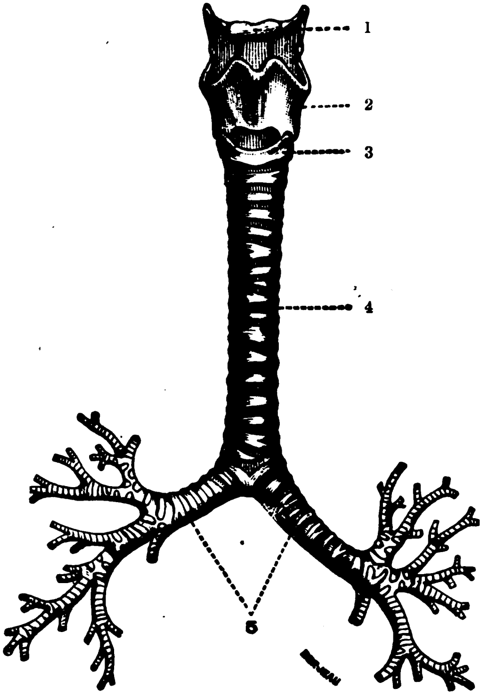


FIG. 72.—THE LARYNX, TRACHEA, AND BRONCHI.

1. Hyoid bone; 2. thyroid cartilage; and 3. cricoid cartilage, forming the Larynx. 4. Trachea or Windpipe. 5. Bronchi.

becoming smaller and their walls thinner as they proceed to their closed endings, the air-cells.

The lungs, two in number, lie in the cavity of the chest, one on either side. Each consists of a mass of minute, extremely thin-walled cells, the air-cells, which are the blind endings of the bronchial tubes. In the extremely thin walls of the air-cells are spread networks of capillaries.

The air-cells thus communicate directly with the external air through the bronchi, windpipe, larynx, mouth, and nose.

159. Description of Respiration.—Respiration or breathing is produced by the alternate enlargement and contraction of the chest-walls, by means of which air is drawn into and expelled from the lungs.

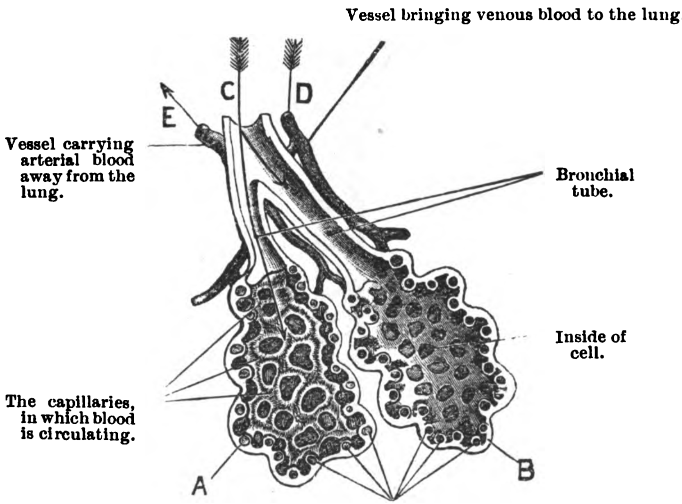


FIG. 73.—TWO AIR-CELLS OF THE LUNG CUT ACROSS (MAGNIFIED).

A, showing the arrangement of the capillaries around the air-cells.
B, showing the appearance of the inside of an air-cell.
C, a bronchial tube. The arrow in it shows the direction of the air during inspiration.
D, a blood-vessel taking the dark blood to be aerated in the cell.
E, a blood-vessel returning the bright aerated blood to the left auricle.

A complete respiration consists of :—Inspiration or drawing-in of air to the lungs, immediately followed by expiration or breathing-out, expulsion of air from the lungs. This is followed by a pause while one may slowly count two.*

A complete respiration occurs in health 15 to 18 times a minute. The rate is increased during exertion and also in many diseases. The act of respiration is carried out in the following way :—

Inspiration.—In inspiration the chest is enlarged by the action of various muscles.

* The importance of impressing the relation to one another of these three phases of respiration becomes manifest when the practice of artificial respiration is being taught.

One of these, the diaphragm or midriff, is situated between the chest and the belly or abdomen. The diaphragm when not in action is arched upwards, being attached to the lower end of the breast-bone, the lower ribs, and the backbone, forming the floor of the chest and separating it from the belly or abdomen. When in action, it contracts and becomes flatter, pushing the belly outwards, and enlarging the cavity of the chest from above downwards.

The ribs pass slanting downwards from the backbone to the breast-bone, and their arches are wider below than above. Various muscles are attached to the ribs which raise them and at the same time carry the breast-bone upwards and forwards, thus increasing the size of the chest, making it broader from side to side and deeper from front to back. As the chest cavity enlarges, air is drawn in through the mouth and nostrils, and passing down the windpipe and bronchial tubes into the air-cells, expands the lungs.

In the lungs it remains long enough to allow the oxygen to pass through the capillaries into the blood. At every breath a little additional air is drawn in, and some watery vapour, carbonic acid and other foul gases passed out. The chest is not completely emptied or filled at each breath.

Expiration.—At the end of inspiration the diaphragm relaxes and becomes more arched upwards: the muscles which raised the ribs and breast-bone cease to act, and the chest-walls fall. Thus, by its natural elasticity, the cavity of the chest is reduced in size and the air, consequently, is expelled from the lungs.

160. The air is made up of two gases—oxygen and nitrogen. Oxygen is what is required in the blood: the nitrogen passes out just as it went in. Oxygen has the effect of making the corpuscles bright scarlet, as in the systemic arteries. As the oxygen passes out of the corpuscles the blood becomes darker in colour, as in the systemic veins.

The Nervous System.

161. The nervous system consists of (1) nerve-centres; (2) nerve-cords, or nerves; (3) nerve-endings.

The nerve-centres are the brain and spinal cord and receive all messages from the skin and organs of sense, sending out orders to the muscles to make them move in any desired way. All the thinking is done in the brain. It is contained in, and protected by, the skull.

The spinal cord proceeds from the brain down the spinal canal, and both brain and spinal cord give off all the nerve-cords which proceed to every part of the body.

The nerve-cords are the connecting threads between the nerve centres and nerve-endings. They are, therefore, attached at one end to the brain or spinal cord, and at the other end terminate in the nerve-endings, whether in the skin, organs of sense, or muscles.

Nerve-endings are to be found in every part of the body; for instance, it is not possible to touch with the point of a needle any portion of the skin which does not contain a nerve-ending.

They are able to communicate to the brain information of what is taking place in the part to which they are distributed. For instance, with the end of the finger we can tell whether anything we touch is rough or smooth, hot or cold. Other nerve-endings in the ear, eye, tongue, or nose send to the brain information as to hearing, sight, taste, and smell. Acting on this information, the brain can send an order to any muscle, or set of muscles, instantaneously, by the nerves which pass into them, and so make them move.

The Digestive System.

162. The digestive system consists of two portions, viz. : (1) a long tube called the alimentary canal, and (2) glands which prepare juices to be mixed with the food and digest it.

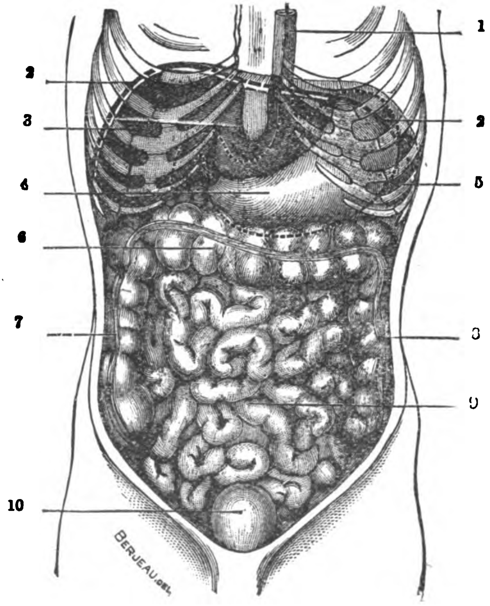


Fig. 74.—The Abdomen.

1. Gullet. 2, 2. Cut edge of diaphragm. 3. Liver. 4. Stomach. 5. Spleen. 6. Transverse colon. 7. Ascending colon. 8. Descending colon. 9. Small intestines. 10. Bladder.

The alimentary canal begins at the mouth and ends at the anus or lower opening of the bowel. It is altogether about 30 feet long.

The different parts of the alimentary canal are the mouth, gullet or œsophagus, stomach, small and large intestines.

The glands, or organs which pour juices into this canal or tube, are the salivary glands in the mouth, the gastric glands in the stomach, the liver which makes bile (two pints a day), the pancreas which makes a juice similar to the saliva, and other glands in the walls of the small intestine.

163. It is necessary for proper digestion that the teeth should be in good order and kept from decay. One great means of preventing decay is to brush the teeth regularly every day. This removes the remains of food, which when left among the teeth helps to cause their decay.

164. The food passes through the gullet from the mouth, after being chewed or masticated and mixed with the saliva, into the stomach. As it becomes sufficiently liquefied by the action of the stomach, it passes gradually into the intestines or bowels, where further digestion takes place, and the unused parts of it are passed out about 24 hours after having been swallowed. While it is passing down the stomach and bowels the nutritive part of it is dissolved and sucked into the blood, through the thin walls of the capillaries on the inside of the stomach and bowels, and passes from thence into the veins, and so into the circulation for the general nourishment of the body.

The Excretory System.

165. It is necessary to life to get rid of impurities and waste matters which accumulate in the blood, and for this purpose the kidneys, bowels, lungs, and skin have the power of gathering these matters, gases and fluid, and passing them out of the body.

The kidneys pass out daily about two and a half pints of urine which consists of water and waste matter from the blood.

The lungs pass out impure gases in the expired air.

The bowels assist in casting out, with the remains of the food, certain impurities.

The skin is continually passing off sweat, which consists of water and impurities from the blood. The skin not only covers and protects the body and has the sense of feeling and touch, but also has in it a number of minute apertures, through which sweat and the natural grease which keeps the skin supple pass out It has a quantity of fat under it, which keeps in the heat of the body. It also regulates the heat of the bodv by means of sweating, which cools down the blood.

In order to keep the skin healthy, great attention should be paid to cleanliness.

The Chest and Abdomen.

166. There are two large cavities in the trunk, namely, the chest or thorax, and the belly or abdomen. The organs of respiration and circulation are contained in the chest ; those of digestion and excretion in the belly.

167. The Chest.—The cavity of the chest occupies the upper third of the trunk and is a cone-shaped chamber the base of which is below. The walls are principally made of a framework of bone, namely, the backbone, the ribs, and the breast-bone or sternum, the spaces between the ribs being filled in by muscles and fibrous tissue. (*See* Fig. 71.)

The chest contains the lungs, heart, the large blood-vessels, and part of the gullet. Above, it communicates with the neck by an opening through which pass the windpipe, gullet, and blood-vessels from the head and neck. Below, it is shut off from the abdomen by the diaphragm, through which pass, at the back of the chest, the gullet leading to the stomach, and the main artery and vein of the body.

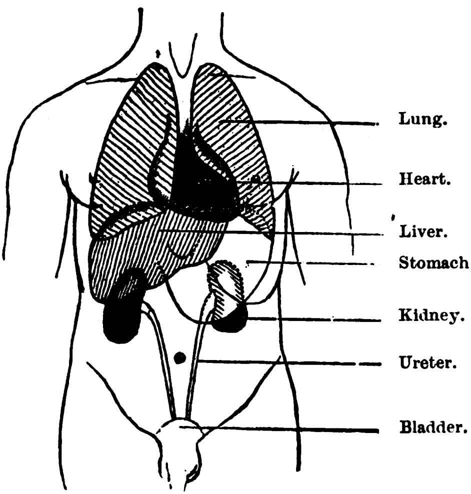


FIG. 75.—A Diagram of the Chest and Abdomen, to show the position of the Organs, as viewed from the front.

168. The Abdomen.—This cavity lies immediately below the chest, being roofed in by the diaphragm. The walls in front and of the sides are formed by layers of muscles, and behind by the backbone. The floor is formed by the pelvis (*see* Fig. 63).

The belly contains the stomach, bowels (small and large intestines), liver, spleen, pancreas, kidneys, and bladder. The liver is a very large organ. It is placed below the diaphragm, under the ribs on the right side, and fills nearly a sixth part of the belly. The stomach is under the ribs on the left side, and varies

in size according as it is empty or full. The pancreas or sweetbread lies across the front of the spine just above the level of the navel. The spleen is a large, soft organ, about the size of the fist. It is concerned in the formation of the blood, and is placed deeply under the left ribs, behind the stomach, and close under the diaphragm. It is apt to be enlarged in certain tropical diseases. The kidneys are deeply placed in the loins, one on each side of the

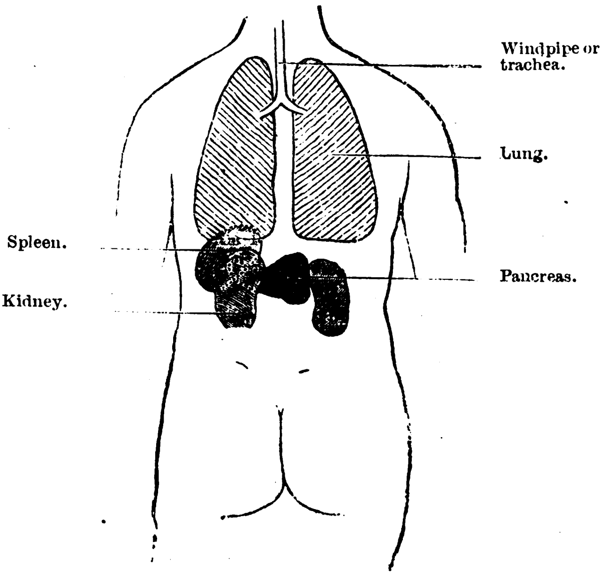


Fig. 76.—A Diagram of the Chest and Abdomen, to show the position of the Organs, as viewed from behind.

backbone, and reach as high as the eleventh rib. They are placed at the back of the abdomen. The bladder is quite low down, in the middle of the front of the belly, and only rises above the pelvis when it is very full. The bowels fill up the whole of the rest of the space in the belly. The urine reaches the bladder from the kidneys by two tubes, called the ureters, one to each kidney. It remains in the bladder until such time as it is convenient to pass it. The tube by which it is passed is called the urethra.

CHAPTER II.

FURTHER INSTRUCTION IN ANATOMY AND PHYSIOLOGY.

THE BONES.

169. Bones are composed of animal matter and lime, and are surrounded by a membrane, called the periosteum, from which blood-vessels pass into the bone to nourish it, and which is essential to its proper union in case of fracture. The longer bones have a cavity in their shaft called the medullary or marrow cavity, containing yellow marrow; in this, as well as in the periosteum, are found blood-vessels for the supply of the bone. The outer layers of the bones are hard and compact, but the inner portions are made of a kind of network of interlacing laths of bone, with spaces between them containing many blood-vessels and red marrow which plays an important part in the formation of the blood. This porous bone is called cancellous tissue.

THE SKULL.

170. The skull (para. 147), as has been said, has many bones entering into its structure, and it is really made up of a number of cavities for the protection of the brain and the delicate organs of special sense (as the eye, ear, and nose), and of other air-cavities which add lightness to its structure and give resonance to the voice. Many bones go to form the brain-case or cranium, and the face with its air-cells and cavities.

171. Cranium.—The cavity of the cranium contains the brain; is continuous with the spinal canal (para. 148), and opens into it by means of a large hole at its base, called the foramen magnum. The bone which has this hole in it is called the occipital bone. On either side of the foramen are the condyles, which are rounded pieces of bone which rest and move upon the topmost vertebra of the spinal column. The whole weight of the skull is thus borne through the condyles upon the top vertebræ of the spinal column.

The occipital bone is permanently united by its fore-end to the sphenoid bone, which forms a sort of keystone to the base of the cranium, and which has wing-like extensions passing upwards and outwards, supporting a great part of the base of the brain. It has other extensions passing downwards which form the back part of the hinder nostrils and give attachment to some of the muscles of the lower jaw.

The great blood-vessels for the brain enter through holes in the base of the skull near the sphenoid bone.

The eye-socket or orbit is partly formed by the wing of the sphenoid, which also appears on the outside of the skull.

Attached to the fore-end of the sphenoid at the base of the skull is the frontal bone ; it has a horizontal part forming the front portion of the floor of the cranium and the roof of both orbits, and a rounded ascending plate which forms the whole of the forehead and the front of the skull.

A small bone called the ethmoid is placed in the front part of the base of the cranium, between the frontal and sphenoid bones, and forms part of the roof of the nasal cavity.

The lateral parts of the base of the cranium are formed by the occipital bone, the temporal bones (which are wedged in between the occipital and sphenoid, but which do not meet in the central portion of the skull's base), the wings of the sphenoid, and the frontal bone ; the dome and sides of the skull by the occipital bone behind, the two parietal and two temporal bones, a small portion of the sphenoid, and the frontal bone.

The base of the skull is very thin in certain spots, such as the roof of the orbit and the roof of the nasal cavity ; these are, however, generally protected by their position. The central portions of the base are very strong, as must be the case to withstand the shock of the weight of the head in jumping from a height.

The cranium contains the brain, from which the nerves of special sense pass through the holes in its base, and is lined by a strong membrane called the dura mater, which supports nerves and vessels, and forms partitions to hold the brain in its place, and which also contains blood-vessels to nourish the inner layers of the skull's bones, as the periosteum does in the case of other bones.

The muscles which move the head and form the flesh of the neck are attached to the base of the skull.

172. Bones of the Face.—The face is formed of a good many bones which, as said, form cavities for the protection of the organs of special sense, and give lightness to the structure of the head and resonance to the voice. These bones, with the exception of the lower jaw, are fixed together immovably (para. 147).

The fixed bones are the superior maxillæ, the malar bones, nasal bones, palate bones, vomar, and turbinate bones.

The upper jaws (superior maxillæ), one on each side, underlie the greater part of the cheeks, carry the upper teeth, and form most of the bony palate, the opening of the nostrils, and the inner side of the eye-socket.

The cheek-bones (malar bones) are small and strong and are joined to the upper jaw-bones by their inner ends, and to the prong (or zygomatic process) of the temporal bone by their outer ends, and form the lower and outer part of the rim of the eye-socket or orbit. They are joined by their upper ends to the frontal bone, which last completes the eye-socket above, and joins with the upper jaw-bone to its inner side.

The two small nasal bones are joined to the frontal bone above, to one another by their inner edges, and to the upper jaw-bone by their outer edges to form the bridge of the nose.

The bony palate is completed by two bones called the palate-

bones, which unite together in the centre, and join the upper jaw in front and form much of the hinder opening of the nostrils into the throat or pharynx.

A thin bone, called the vomer, forms the division between the nostrils, passing from the base of the skull and the ethmoid bone above, to the junction of the palate and palate portions of the upper jaw-bones below.

There are some very thin, curled bones called the turbinate bones, fixed to the outer walls of the nasal passages, projecting into the passage, and which are covered with mucous membrane which has many large blood-vessels in it, in order to warm the air as it passes through the nostrils to reach the lungs. These bones also serve for the spreading out of the nerves of smell in the upper part of the nostrils.

173. There are numerous air-chambers opening into the nasal passages, a very large one being situated in the back part of the upper jaw above the back teeth, and there is one in the forehead behind the brow in the thickness of the frontal bones; others exist between the two eye-sockets and above the back part of the nasal passages.

174. The lower jaw-bone is strong and heavy and carries the lower teeth. It is flattish in section, and bent on the flat at its centre which forms the chin, and edgeways behind the rows of teeth to form two upward projections for attachment to the temporal bones of the cranium with which it is articulated. The upper ends of these two projections are rounded and smoothed to form a movable joint. They are called condyles.

Very powerful muscles are attached to the lower jaw. One, called the temporal muscle, covers much of the side of the skull, and passes beneath a bony arch, formed by the temporal prong or zygomatic process and the malar bone, to be attached to the upper projection of the lower jaw in front of its rounded articular head or condyle. Other very strong muscles are attached to both sides of it lower down, and by their other ends to the bones of the face and the downward-projecting plates of the sphenoid bone (see Cranium), which muscles give the side-to-side movement of the jaw (the temporal muscle simply moving it up and down).

175. Special sense organs located in face cavities.—It has been mentioned that most of the organs of special sense are located in the cavities of the face. The eyes are contained in the orbits or eye-sockets, formed as described; the organ of smell is contained in the upper part of the nasal passages, the lower part of these passages being for breathing. The internal ear is in the thickness of the temporal bone, and the external meatus or earhole opens behind the joint of the lower jaw. The internal ear has a communication with the back of the throat through a tube called the Eustachian tube. The sense of taste is situated in the tongue and palate.

176. The Teeth.—There are two sets of teeth grown in a lifetime from the upper and lower jaw.

The first set, which is complete in childhood, is of twenty teeth only, and these in grown-up people give place to thirty-two.

The teeth in both halves of the upper and lower jaw and in the two jaws correspond in number and shape. The eight front, chisel-shaped teeth are called incisors or cutting teeth; the four on each side of these are called canines or dog-teeth. In childhood there are eight grinding teeth behind these, called molars. Adult people have the same number of incisors and canines, but in place of the eight molars of childhood they have eight bicuspids or narrow grinders with two points or cusps each, and in addition twelve molars with three or four points each. Those four furthest back are called the wisdom teeth, and may not come through till the age of thirty.

The child teeth are called "temporary" and the adult teeth "permanent." The buds of both sets are contained in the thickness of the jaws at birth.

The Spinal Column.

177. Vertebræ.—The vertebræ (para. 148) are a number of bones which make up the spinal column. They form a jointed, elastic pillar for the support of the trunk and skull by means of their bodies, which are placed one on top of another with cushions between them (the intervertebral fibro-cartilages). The spinal column so formed gives attachment to the ribs and limbs.

The vertebræ have projections from the hinder part of their bodies forming rings, and those rings placed one above the other form the spinal canal, a bony canal which encloses and protects the spinal cord. Projecting from the sides of each ring are two lateral bars called transverse processes, which in the twelve dorsal vertebræ support the ribs; and from the back of the ring project central pieces called spinous processes, which can be seen and felt under the skin of the back as knobs of bone.

178. Regions of Spine.—The different regions of the spine receive different names, each containing a certain number of vertebræ; these are:—The neck or cervical region with seven vertebræ; the back or dorsal region with twelve; the loins or lumbar region with five; the sacrum with one piece of bone consisting of five vertebræ welded together; and the coccyx or tail with four joints which are incomplete vertebræ.

The Muscles.

179. Structure and Action.—Muscles (para. 152) are responsible for all movements of the body, whether under the control of the will or not, and all movements are caused by impulses travelling along the nerves to the muscles. Consequently all muscles have nerves passing into their substance, and branching so as to give a nerve-fibre to each muscle-fibre.

Muscles are made up of threads or fibres, which in a simple muscle lie side by side, enclosed in a sheath, and generally end in

tendons at one or both ends attaching them to bones or other parts they are intended to move. The movement of these bones or parts is caused by the muscle contracting or shortening itself in response to the impulse sent along its nerve, and so bringing its points of attachment nearer together and moving the part, *e.g.*, bending or straightening the limb.

The muscles moving the head, trunk, and limbs are under the command of the brain and are termed "voluntary" muscles. They are made up of fibres which are striated, *i.e.*, striped transversely, and are capable of most rapid movements, and movements of very complicated kinds. The muscles of the limbs are grouped to perform such habitual actions as walking, bringing the hand to the mouth in taking food, &c. There are, however, muscles, such as those of the heart and intestines, which are not under control of the will. Such muscles are said to be "involuntary." Involuntary muscles (with the exception of that of the heart) are not striped, and are of paler colour as a rule than the striped ones. They are slower in their movements and carry on the more mechanical functions of the body. They are under the control of the sympathetic system of nerves. Layers of involuntary muscles surround the blood-vessels and the alimentary canal, the calibre of which they control, and it is by their means that the contents of the intestines are pushed along.

180. Blood-supply.—Muscles are very freely supplied with blood as every movement causes the consumption of some of their substance, which must be removed and replaced, otherwise they would soon be clogged and so prevented from doing more work. The well-known feeling of stiffness after severe exercise is due to the accumulation of waste products in the muscles.

181. Muscular development.—Moderate exercise and good feeding enlarge the muscles : disuse and poor feeding cause them to dwindle. Great development of muscle is seen in persons who systematically exercise every muscle.

The effect of disuse in causing the dwindling or atrophy of the muscles is particularly striking in the case of a stiff joint, when the limb affected may decrease to half its proper size. When the nerves supplying muscles are destroyed, the condition of the muscle which becomes powerless and would otherwise atrophy can be preserved to a certain extent by massage and passive movement. Muscles can be made to contract by the electric current, which is often used to keep up their activity in cases of paralysis.

182. Internal work done.—There is always much muscular work going on in the body, even during sleep ; and when it is considered that the heart never ceases to beat, that the breathing-muscles never rest, and that the food in the alimentary canal is continually kept moving by muscular action, it is not surprising to find that enough energy is daily expended (without counting what is used in external and visible work) to raise a weight of 260 tons to a height of 1 foot in the twenty-four hours. The body tissues, particularly the muscles, also produce by their slow combustion a

great quantity of heat, enough in the twenty-four hours to boil sixty pints of water, previously at freezing point.

183. Necessity for oxygen.—The combustion or burning of the body-tissues, as in the case of every fire, requires oxygen to keep it up and produces carbonic acid gas. When, as in making great exertion, the rate of the breathing is much increased, it is because more oxygen is wanted to supply the muscles in action, as it is only by spending them that movement can take place.

THE NERVOUS SYSTEM.

184. The nervous system (para. 161) is the most delicate and complex of all the parts of the body. The great difference between human beings and other living creatures consists in the high development of their nervous system.

185. Cerebro-spinal.—The brain and spinal cord are the centres of the "cerebro-spinal system." which is the voluntary and will-controlled system.

186. Sympathetic.—There is a system of nerves called the sympathetic system, which consists of chains of ganglia or knots, connected together and to the spinal nerves, and which automatically regulate the movements of the vital parts and blood-vessels which are not controllable by the will. This system is to be found in the very lowest animals, which have no brain proper, and no spinal cord.

187. Brain.—The brain consists of countless numbers of nerve-cells and nerve-fibres; the nerve cells are in two great masses called the cerebrum or brain, and the cerebellum or small brain. The spinal cord also contains masses of nerve-cells. The cerebrum and cerebellum are contained in the cranium, the brain being uppermost.

The cerebrum consists of two halves or hemispheres, which are to all intents duplicates of one another. The halves are united together and to the cerebellum below, and are separated above by a deep furrow from front to back, into which a partition of the dura mater fits. The outer surface of the brain is covered with rounded ridges and furrows, and is plentifully supplied with blood-vessels which run into these furrows. The main blood-supply of the brain passes into its base.

From the base of the brain nerve-cords proceed, viz., the nerves of smell, sight, hearing, and taste, and for the movements of the eyes, tongue, jaw, and the muscles of the face.

188. Spinal Cord.—At the junction of the spinal cord with the brain, there is a piece of the cord called the medulla oblongata from which come very important nerves governing the movements of the heart, of breathing, and of the stomach; and the spinal cord contains all the nerve-centres for the lower physical functions of the body.

The spinal cord proceeds from the base of the brain and is contained in the spinal canal. It extends as far as the upper

lumbar vertebræ. From the spinal cord a pair of nerves passes between every two vertebræ for the sensations and movements of the trunk and limbs.

189. Functions of the Brain.—The cerebrum is the seat of thought, the higher voluntary originations, and is the seat also of most of the special senses; while the cerebellum serves to "co-ordinate" or combine the various groups of muscles in movement which together carry out such habitual actions as walking and eating. It is possible for life to continue for a time without the higher brain, as the centres for the mere vital and non-intellectual functions are in its base and in the medulla and spinal cord. Breathing and swallowing can go on even when, as in concussion of the brain, sensibility is quite absent, but if the nerve-centres which govern the vital functions are in any way interfered with, instant death is the consequence.

To perform any voluntary movement an impulse must proceed from the brain to the nerve moving the muscles required, and there must always be some reason for the movement which, however, may be physical or mental.

There are, again, many acts which are not performed intentionally, though they are done by the voluntary muscles; the acts, for instance, of coughing, sneezing, vomiting, yawning and hiccupping are independent of the will, and are what are called *reflex* acts, that depend upon the state of the air-passages and digestive organs and the impulse causing the muscular movement proceeds from centres in the medulla and spinal cord, short of the higher brain.

190. Sensory and Motor Nerves.—Nerves are either "afferent" or sensory nerves which convey sensations to the nerve-centres, or "efferent" or motor nerves which convey impulses from the nerve-centres to the muscles. All nerves are in connection by their central ends with nerve-cells.

The sensory nerves are the nerves of the special senses, *e.g.*, sight, taste, smell, and hearing, and those of common sensation carrying impressions of heat, cold, and pain. The motor nerves cause the muscles to move, the glands to produce their secretions, and the blood-vessels to enlarge or contract.

The nerves are made up of many strands of fibres, which are insulated like wires intended to carry electric currents. The great sciatic nerve, which passes into the thigh, is the largest nerve in the body and is as thick as the little finger.

191. Injury to Nerves.—Injury to nerves causes paralysis of the parts they supply, *i.e.*, loss of sensation and of the power of movement, and the nourishment of the paralysed parts also suffers; bed-sores are especially likely to occur in paralysis.

The spinal cord consists principally of nerve-fibres coming from the brain to supply the trunk and limbs, and when it is torn through or badly crushed paralysis of both sides of the body is the result, extending as high as the point of origin of the lowest uninjured nerves coming off from it.

When a nerve is completely severed it may be repaired in time, but it takes long, and sensation and power are only gradually recovered.

The Blood and Blood-vessels.

192. White Blood-corpuscles.—The blood and its circulation have already been described briefly (paras. 153 to 157). In this description no mention was made of the white blood-corpuscles These bodies, though not so numerous as the red corpuscles, have very important duties in the body. There are about 500 red to one white corpuscle.

The white corpuscles have the power of altering their shape, and of passing through the walls of the capillaries ; and they also seize and envelop and destroy germs of disease which gain access to the blood, thus protecting the body from invasion ; when an injury has been done to some part of the body and it has become inflamed, the white corpuscles flock there in great numbers to deal with the cause of the inflammation, and if they are successful in removing it, they return into the circulation ; if not, they become pus-corpuscles, which may be regarded as dead white blood-corpuscles, collections of which form abscesses.

The white blood-corpuscles are made in the spleen and lymphatic glands.

193. Red Blood-corpuscles.—The red corpuscles have been described in para. 154. They are coloured by a compound of iron, which is called *hæmoglobin*, and the red colour of the blood is entirely due to them. Their principal duty is to absorb oxygen from the air taken into the lungs (para. 159), and to carry carbonic acid gas from the system to the lungs, where it passes into the air in exchange for the oxygen, and is breathed out (*see* under The Muscles).

194. It must always be remembered that every movement causes the combustion or spending of some of the body tissues, and the result is transference of energy to some object, such as a cricket-ball when thrown, and secondly, the production of heat, and thirdly, the formation of carbonic acid gas or carbon dioxide, which is the gas produced by all burning or rapid oxidation of organic matter. To make combustion possible there must always be a supply of oxygen, and the necessity for the continuous supply of oxygen from the lungs and its carriage to every part of the body by means of the blood is apparent when the above-described conditions are understood.

195. Blood-plasma.—The fluid part of the blood in which the corpuscles float (para. 154) is called *plasma*, and its function is to carry nourishment to the tissues by passing or soaking through the walls of the capillaries, and to take up waste products from the tissues and carry them into the lymphatic system (*see* under Lymphatic System), returning to the blood-stream by way of the thoracic duct.

196. Blood-vessels.—All the blood-vessels are surrounded by muscle-fibres, which, however, are more numerous in the arteries than in the veins, and these fibres by their contraction regulate the calibre of the vessels and admit more or less blood to the parts they supply.

197. It must be borne in mind that all the work of the blood is done in the capillaries while it is moving slowly and that there is far more blood in the venous system than in the arterial. The vessel-muscles are under the control of the sympathetic system of nerves. Flushing and pallor are caused by the dilating and contracting, respectively, of the capillaries of the skin, and are caused by emotion, heat, cold, pressure, &c., acting on the local sympathetic ganglion, whether through the brain or reflexly.

198. The blood supply of vital organs.—In is important that the supply of blood to all parts of the body should be uninterrupted, and that the vital organs should receive a copious supply. The vital organs, therefore, are placed in the chest and abdomen near the heart, which is the source of supply. The brain, which is a little further off, has a particularly free supply, being fed by four large arteries, into two of which (the carotids) the blood passes direct from the arch of the aorta; the two other (the vertebrals) are branches of the subclavians which come from the arch of the aorta.

199. The arrangement of main vessels of the limbs.—The main arteries of the limbs are so placed that they are protected from pressure and stretching, which would arrest the flow of blood through them; in the case of the limbs the most protected side is the flexor side, *i.e.*, that towards which the limb bends.

The artery of the upper limb, for instance, passes underneath the collar-bone, and thence deeply into the axilla or arm-pit; then passing down the inner side of the humerus it goes in front of the bend of the elbow, where it divides into two branches which pass down on the inner side of the fore-arm (when the arm hangs in a natural position), and pass over the wrist on the side towards which it bends; the deep palmar arch formed by the junction of these two arteries is protected from pressure by being buried beneath the tendons deep in the palm of the hand.

In the lower limb, the main artery after passing out of the abdomen gains the centre of the groin (which is on the flexor side of the thigh), and then passes deeply down on the inner side of the thigh till it arrives at the middle of the back of the knee-joint. It divides into two branches a little distance below the knee, one branch keeping along the back of the tibia and going to the inner side of the back of the ankle, the other running down the front of the leg between its muscles to reach the front of the ankle, the two meeting in the sole of the foot where the plantar arch formed by them is placed in such a position under the arch of the instep that it cannot be compressed by the weight of the body in the standing position.

"CIRCULATORY SYSTEM"

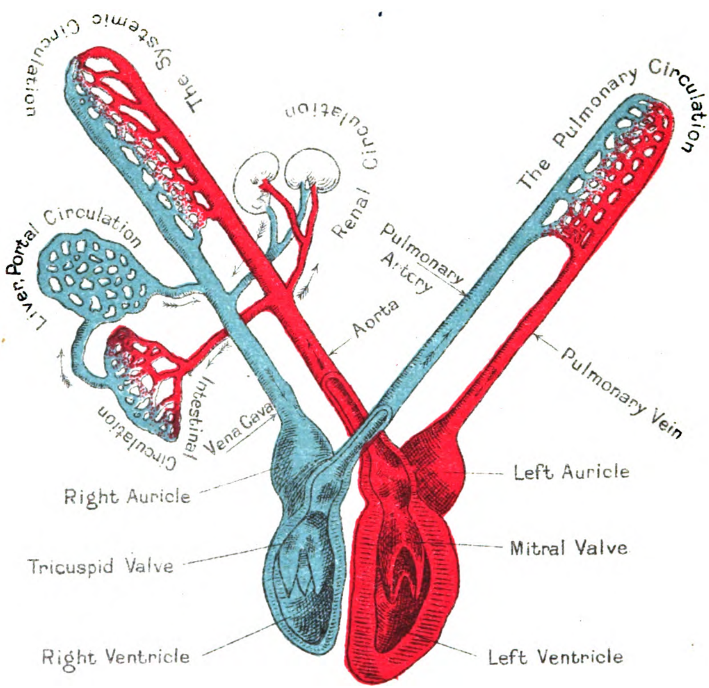


Fig. 77. *Diagram of the circulation of the blood*
The ventricles are seen in section to show the valves
The right & left side of the heart are shown separated.

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"BLOOD VESSELS"

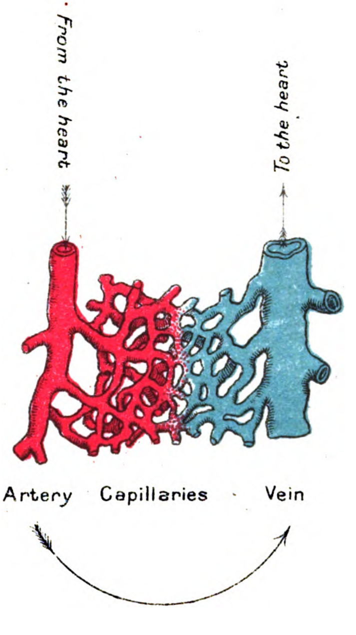

Fig. 78. *Diagrammatic sketch to show the three classes of blood vessels*

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The Portal Circulation.

200. When describing the systemic circulation, it was stated that the blood in the systemic capillaries takes up nourishment from the stomach and bowels, but it was not mentioned that the whole of the veins which carry blood from the alimentary canal pass into a large vein called the portal vein, which splits up in the substance of the liver into which it enters. After passing through the interstices of the liver the blood is gathered into the hepatic or liver-veins and by them passed into the main vein which enters the heart.

In the kidneys, also, there is a secondary circulation of similar description.

The Lymphatic System.

201. There is a circulatory system in the body which has not yet been alluded to, called the lymphatic system. It will be remembered (para. 156) that liquid nourishment is conveyed in the blood to every part of the body by the blood-vessels, and oozes through the thin walls of the capillaries into the tissues, from which certain waste matters soak back into the capillaries and are conveyed into the veins. But the greater part of this necessary absorption is carried on by the lymphatic system, which receives the name of "absorbent system," also, on account of its important functions.

The lymphatic system is made up of :—(*a*) Lymphatic capillaries and lymph-spaces, into which fluids from the tissues soak, and which are to be found in every part of the body; (*b*) lymphatic glands, to which all the lymphatic vessels converge and which are factories of white blood-corpuscles and in which filtration of the lymph takes place ; (*c*) large lymph-vessels which collect lymph after it has passed through the glands, and empty it directly into the blood as it passes towards the heart in the vein ; (*d*) the lymph itself, which is a clear, colourless, or faintly yellow fluid such as is seen in a blister. The lymph which passes from the intestine during digestion, however, becomes milky from being charged with fat.

202. Movements of the lymph.—The lymph is constantly moving from the extremities towards the centre. A large lymphatic vessel which returns it into the great vein in the chest is called the thoracic duct.

There is no outward-going stream as in the case of the blood-circulation, and no heart to drive the lymph ; but all the vessels have many valves, and every movement of the body moves it forward and the valves prevent its return.

203. Lymph-capillaries.—Lymph-capillaries are larger and less regular in shape than blood capillaries, and commence in spaces in the tissues ; they are to be found in all parts of the body, as also are blood-vessels, and by their junction they form lymphatic vessels which join and branch to form networks of lymphatics, and pass into and out of the lymphatic glands.

204. Lymphatic glands.—The lymphatic glands are small bodies which are situated in various parts of the body, such as the bend of the knee and elbow, the groin and axilla, the back and sides of the neck, the mesentery, and the root of the lungs; each set of glands receiving the lymph from the parts of the limbs and organs near which it is situated. If there is a "septic" or festering sore on the foot, the glands below the fold of the groin become inflamed from the poisoned lymph they have intercepted; in case of such a sore occurring on the hand, the glands in the axilla are affected. In some general diseases the glands all over the body become enlarged. Medicines which are rubbed into the skin, and those also which are hypodermically injected, become diffused by means of the lymphatic system.

205. Lacteals.—The intestines are highly equipped with lymphatic vessels which take an active part in the absorption of fats into the system, and are called lacteals; they are found in the *villi* (Fig. 80). These carry the digested fats into the mesenteric lymphatic vessels, which pass it into the thoracic duct which discharges into the great veins of the root of the neck.

206. Organs of a lymphatic nature.—The tonsils, Peyer's patches (see para. 212), and parts of the spleen are of the nature of lymphatic apparatus.

The Digestive System.

207. By digestion is understood the preparation of food to be received into the blood.

It is obvious that before it can be absorbed it must be dissolved.

208. Swallowing.—Food, which must consist of proper proportions of certain substances, viz., meats, fats, starches, salts and water, is first placed in the mouth, where by the movements of the tongue and cheeks it is turned about and crushed between the teeth, the saliva running into it, until it is mixed up and can be swallowed; this is done by the tongue pushing it into the upper part of the throat or pharynx, whose muscles seize it and pass it quickly down over the top of the larynx which is covered by the flap of the epiglottis until it has passed; the muscles of the œsophagus now push it into the stomach

The saliva begins the digestion of the starchy parts of the food.

209. Stomach.—The food remains in the stomach, which is represented in Fig. 79 as a very thick bag with a slight constriction in the middle. This constriction does not really exist, but is illustrated to show that the digestion in the stomach has two phases and that two different sorts of glands are at its opposite ends, producing two different sorts of gastric juice. The peptic glands are situated at the left end of the stomach (its first part), and the acid-forming glands towards the pyloric end, on the way to the intestine. The pyloric funnel-shaped end of the stomach itself has no acid-forming glands, but has alkaline pepsine-glands.

THE DIGESTIVE SYSTEM.

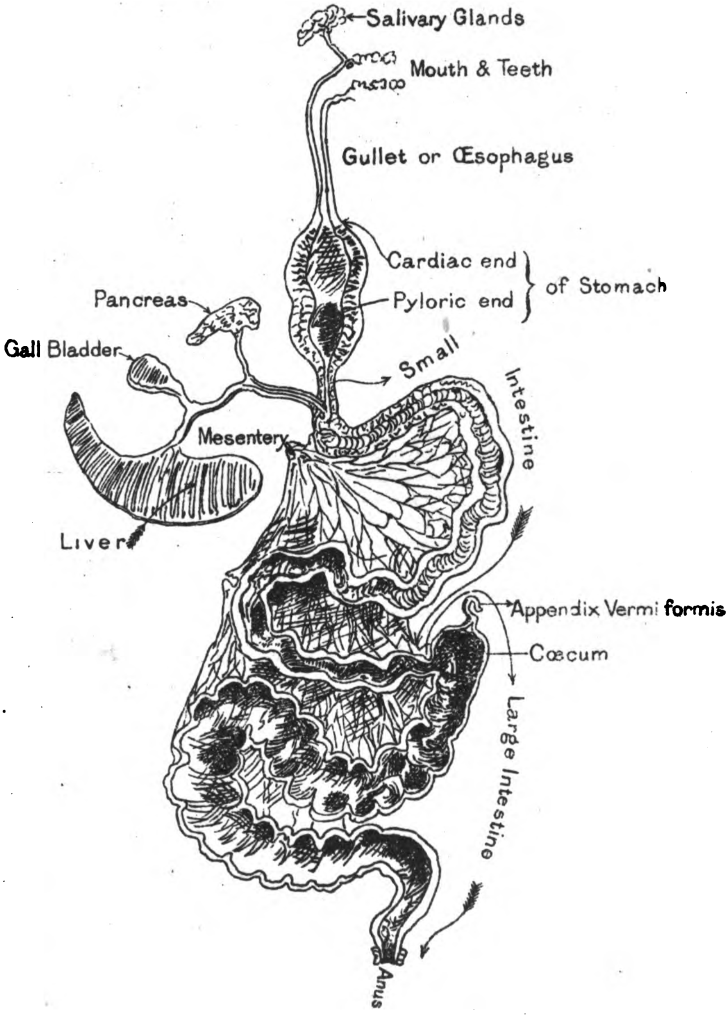

Fig. 79. *Diagram to show Regions of Alimentary Canal. The Alimentary Canal is shown in section and the mesentery is diagrammatic.*

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Food remains about four hours in the stomach, after which it is pressed out into the upper end of the small intestine or duodenum in an acid condition. The digestion of meat is done to a considerable extent in the stomach. A short distance down the intestine the duct carrying the bile and juice of the pancreas opens into it, and these juices are poured into the liquid food which is coloured yellow by the bile.

210. Small Intestine.—The small intestine is about 22 feet in length, and it and the greater part of the large intestine are attached to the spinal column by a double layer of membrane called the mesentery, between the folds of which the blood and lymph vessels and nerves pass to and from the intestine. The mesentery also serves to prevent the intestine from kinking, as any unattached coil would be sure to do.

The interior of the upper part of the small intestine has its lining raised into transverse ridges, called *valvulæ conniventes*, which prevent the too rapid passing of the liquid food and form a large surface for digesting and absorbing it. The whole length of the small intestine has its inside covered with small projections called *villi* (see Fig. 80), which have inside them blood-vessels and lymphatics (lacteals), and are bathed in the digested food and suck it up as it passes along. There are also many small glands in the walls of the intestine. These produce a digesting juice, which acting with the pancreatic juice and the bile, continues the digestion of the contents of the intestine and turns them alkaline; they were acid on leaving the stomach. The digestion of meats is completed by the pancreatic and intestinal juices; that of starches by the pancreatic juice; and that of fats, principally by the bile.

211. The intestines are furnished with circular bands forming a complete layer of involuntary muscular fibres, and also with a

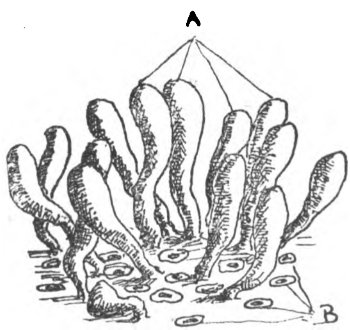

Fig. 80.

Diagram showing part of the interior of the small intestine with projections ("villi"), marked A, for absorbing digested matter, and recesses, marked B, for pouring out digestive fluid.

longitudinal layer. These contract slowly and in regular time, waves of contraction proceeding from the upper towards the lower end of the tube, and squeezing the food onwards; these movements are called *peristaltic* movements or *peristalsis*.

In the small intestine the fæces begin to acquire their foul smell; and its contents cease to be antiseptic, as they were in the stomach.

212. Large Intestine.—The contents of the small intestine pass into the large intestine, which begins in the right iliac fossa. The large intestine, which is about five feet long, begins in a blind bag-like head, into the side of which the small intestine opens; this head is called the cæcum. Attached to it is the vermiform appendix. It is this small, worm-like appendix which is affected in the disease called appendicitis.

The large intestine passes upwards in the right flank, then across the abdomen, then downwards through the left flank into the left iliac fossa, where it makes a double bend called the sigmoid flexure, and finally, the last part of it, called the rectum, goes downwards in front of the sacrum and coccyx and ends in the anus (*see* Fig. 79).

The process of putrefactive digestion is completed in the large intestine, and its contents become drier and formed in its lower end. The fæces are retained in the upper part of the rectum till it is convenient to void them.

The large intestine is provided principally with mucous glands whose secretion lubricates the passage of the fæces. In the lower part of the small intestines are masses of lymphoid glands called Peyer's patches, and single lymphoid glands. In the large intestine are single lymphoid glands. These lymphoid glands have no openings, and appear to have some connection with the lymphatic system.

213. The anus is kept closed by means of the sphincter muscles (of which there is an inner and outer one) until it is desired to defecate. These muscles act like purse-strings, being arranged circularly around the opening. The fæces are the undigested remains of food, mixed with the useless remains of the digesting fluids, and some matters excreted from the system; and the whole mass is coloured by the bile and impregnated with foul gases.

The Urinary System.

214. This is one of vital importance to the body, inasmuch as it takes the largest share in the excretion (or getting rid) of waste products of the body, which would otherwise clog its organs and destroy life. This actually happens when the kidneys are destroyed by disease.

The urinary system consists of the kidneys, the ureters (two tubes which conduct the urine from the kidneys to the bladder), the bladder, and the urethra (a tube which conducts the urine from the bladder to be passed out of the body).

215. Kidneys.—The two kidneys are situated in the abdominal cavity (para. 168, Fig. 75), one on each side of the spinal column.

THE URINARY SYSTEM.

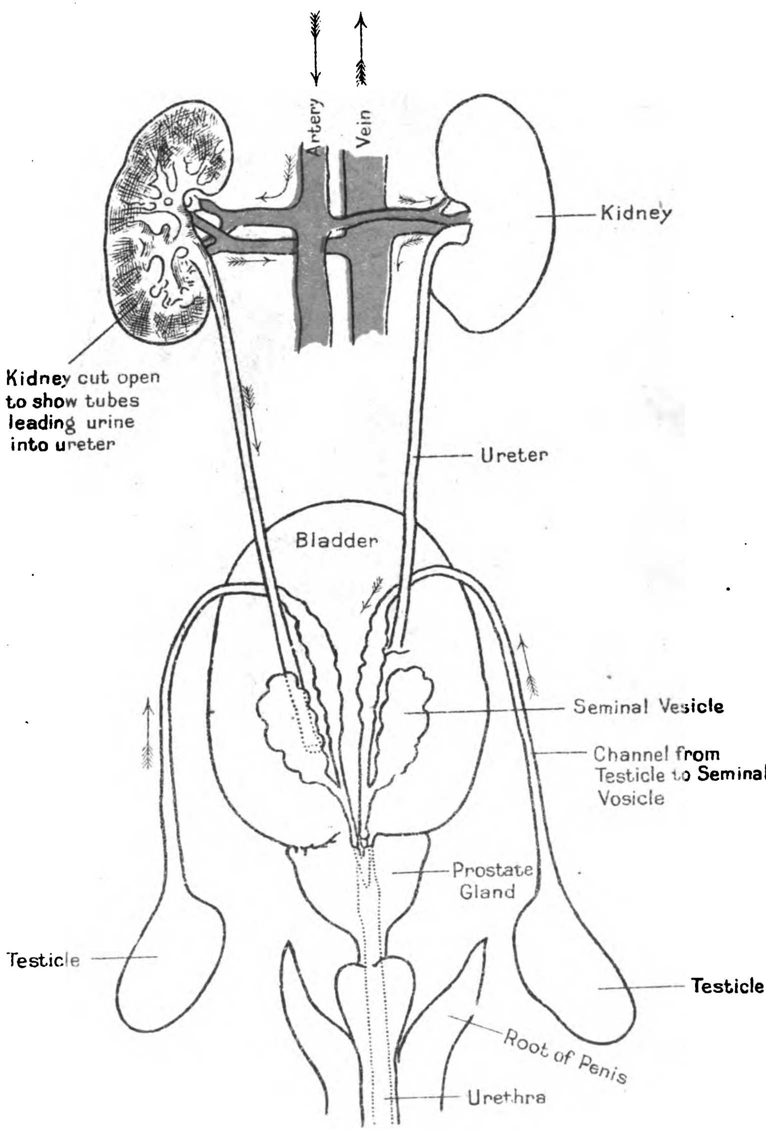

Fig. 81. *Diagrammatic sketch of genito-urinary organs*

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"SECTION OF MALE PELVIS"

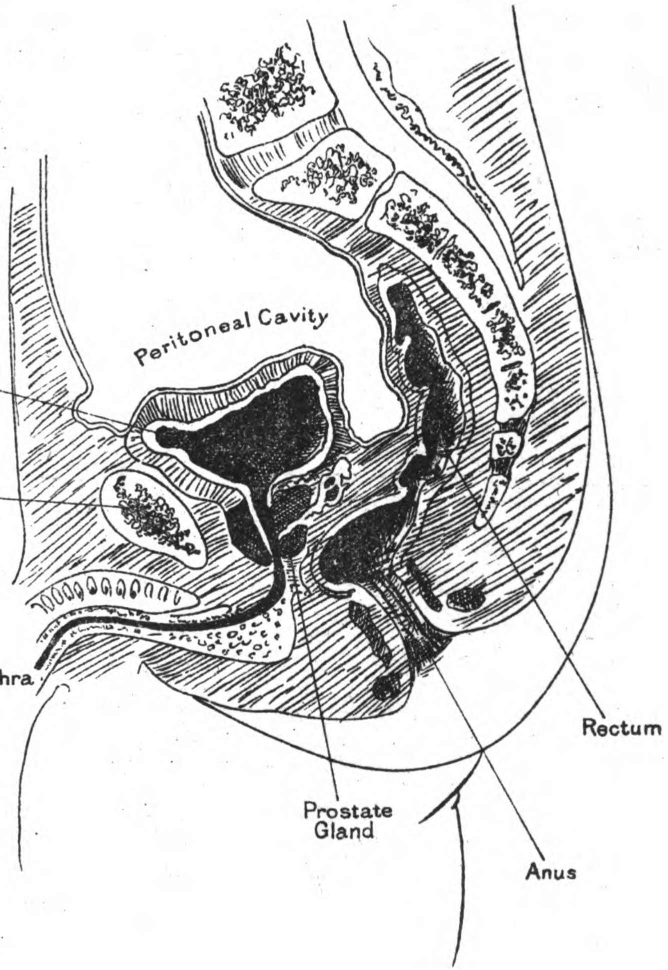

Fig. 82. *Section from front to rear of a male pelvis to show positions of bladder & rectum & the course taken by the urethra, notice the direction of the anus with view to passing nozzle of enema syringe.*

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They lie behind all the other contents of the abdomen, and their upper parts are as high as the last rib. They have each a very large artery passing in, and a vein passing out of them, on their inner and front edge; the ureter comes out behind the vein and artery and goes down to enter the lower and back part of the bladder.

216. Bladder.—The bladder is situated in the pelvis (para. 168). It is a bag which is fixed at its base, and free to expand upward. It will hold comfortably about one pint. It lies below all the intestines, and only rises into the abdomen when very full. It opens into the urethra at its lower part, and in the male at its neck has a gland called the prostate gland, through the middle of which the urethra goes. The receptacles for the semen lie behind the bladder at its base, and the tubes which conduct the semen from the testicles to the receptacles lie against its side.

The bladder has strong layers of involuntary muscle fibres which help the abdominal muscles to squeeze the urine out of it into the urethra, and which exercises pressure upon its contents at all times.

217. Male Urethra.—The urethra in the male (to which sex these remarks alone refer) is about 8½ inches long and ¼-inch in diameter. It passes out from the base of the bladder through the prostate gland (*see* Fig. 82) in a downward direction, then curves forward to pass beneath the junction of the two pubic bones, joining with the two lateral roots of the penis along whose under surface it runs, ending in the orifice at its tip. Just after it has passed through the prostate glands, the openings of the seminal receptacles pass into the urethra. The rectum (lower end of large bowel) lies behind it as it passes the prostate. The situation of these parts is very necessary to know, as the introduction of the enema syringe's nozzle, and the passing of catheters properly, depends on such knowledge.

218. Action of the Kidneys.—The kidneys may be regarded as filters through which the whole blood of the body passes, and which remove from the blood a substance called *urea*, together with other impurities, dissolved in water, which together constitute the urine. The amount of urine passed off in a day is about 50 oz., or 2½ pints. This quantity of urine contains about 2½ oz. of solid matter. The urine is more watery and abundant in cold weather, as less water is then passed off by the skin than in hot weather.

As above stated, if the kidneys cease work from disease or other cause, the blood soon becomes poisoned by the accumulation of these matters in it, and "uræmia" with convulsions and insensibility results.

219. Structure of the Kidneys.—The kidneys consist of minute tubes which are folded and twisted, and end in small bags, each of which receives a tuft of capillary blood-vessels called vascular tufts. At their other ends the tubes open into the commencement of the ureters, in the "pelvis" or concave side of the kidney.

The water of the urine passes from the blood into the little bag at the ends of the tubes through the tuft of capillaries, and as it

runs down the tube it is joined by the urea and other substances produced by the cells lining the tube walls, forming the urine. The cleansed blood passes on in its vessels, and the urine drains into the ureters and finally into the bladder.

The renal artery and vein are very large, and the blood passes through the kidneys rapidly.

220. Retention.—The urine is passed from the bladder as convenient, or when the bladder is full. When from any cause the water cannot be passed, "retention of urine" is said to occur.

To draw the water from the bladder an instrument called a catheter is used. It is a tube with a hole in the side near the end of it and is passed in at the orifice of the urethra until it reaches the bladder, the urine running through it.

221. The Mouth.—The cavity of the mouth can be easily inspected, and needs little description. The teeth have been noticed (*see* under Skull).

The tongue is a muscular organ which is fixed at its base to the hyoid bone, a small curved bone which is to be felt just above the prominence of "Adam's Apple" (the larynx) under the skin in front of the neck. The tongue is covered with a rough skin on the top which has in it the nerves of taste, chiefly at the sides and back. Sweet, acid, salt, and bitter are the tastes perceived by the tongue and palate ; all other "tastes" are perceived by the organ of smell. The tongue can move in most directions, and is particularly active in the mastication of food, and in speech.

There are several glands which produce saliva and are called salivary glands, situated near and opening into the mouth ; they are the parotid glands, which lie just below the ear, and near the angle or "corner" of the jaw ; the sublingual glands, which lie under the tongue ; and the sub-maxillary glands, which are inside the angle of the lower jaw. There are also many glands which pour out mucus and keep the mouth moist.

222. The Fauces.—The epiglottis is a cartilaginous flap covered with mucous membrane, situated at the back of the tongue and immediately above the entrance to the larynx ; it is attached by ligaments to the back of the tongue, the side-wall of the pharynx, and the hyoid bone and thyroid cartilage. Near the back of the tongue on each side of the pharynx are seen the two pillars of the fauces enclosing the tonsil between them. The roof of the fauces is formed by the soft palate, attached to which is seen behind the pendulous part or uvula.

In swallowing, the larynx is drawn up by various muscles, the opening of the larynx being closed by the epiglottis ; the "bolus" or mass of masticated food is at the same time gripped by the muscles of the pharynx and gullet and so passed on to the stomach.

223. The Pharynx.—The pharynx is the cavity into which the mouth, and above it the posterior nares, open ; it is like a "hopper" or funnel, and is suspended from the base of the skull, and continues down to the œsophagus behind and to the larynx in front. It

NASAL PASSAGES &c.

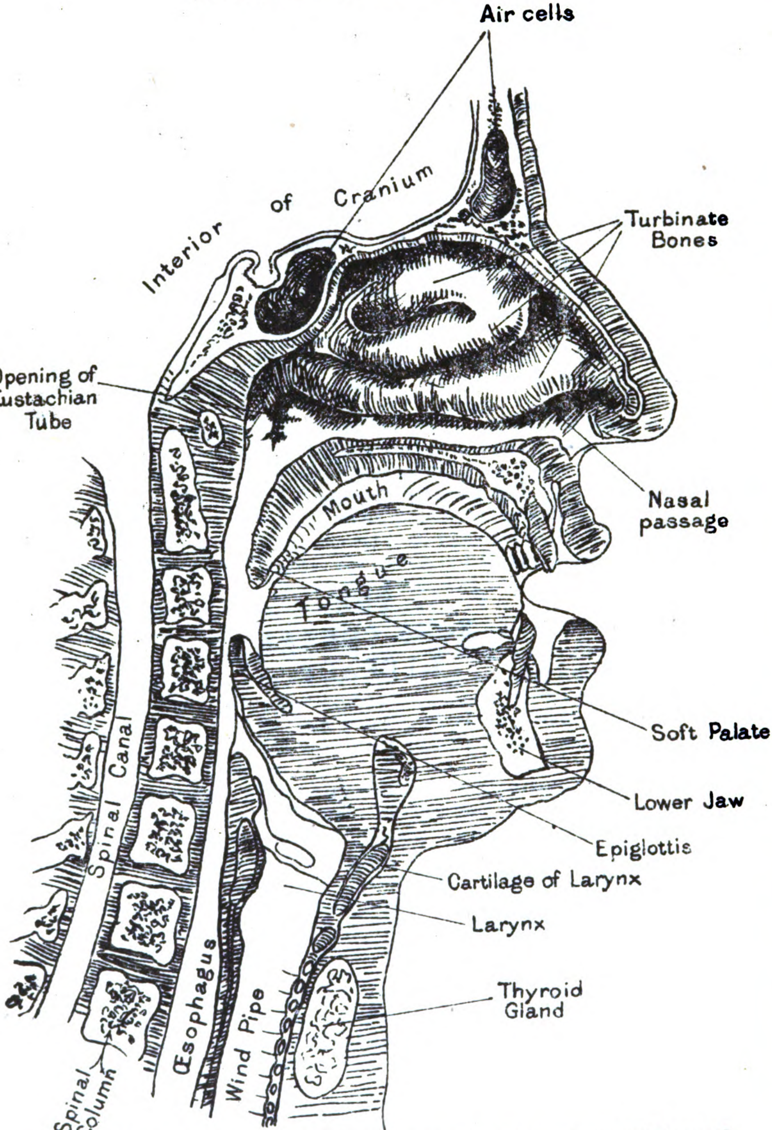

Fig. 83. *Section through head and neck to show positions of nasal cavity, mouth, œsophagus & larynx Slightly to left of mid-line.*

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"FOOD AND AIR PASSAGES."

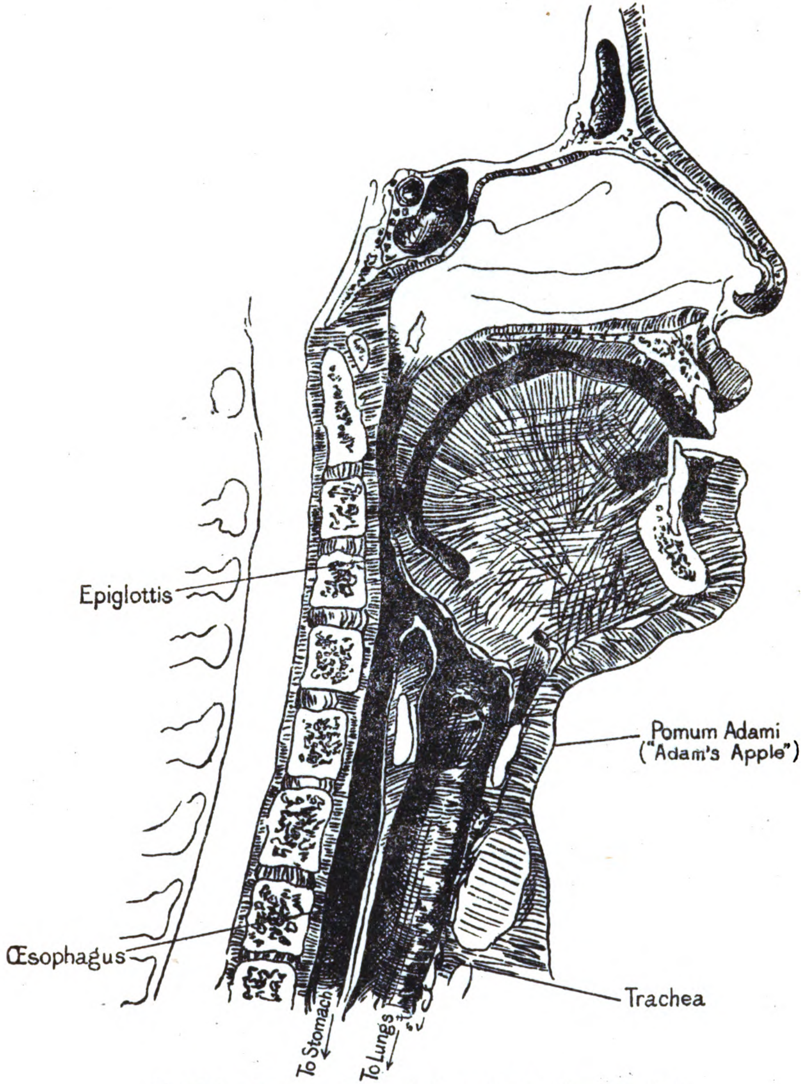

Fig. 84. *Section of head & neck to show food & air passages.*

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has as its back the spinal column covered by muscle, and it is formed of muscles lined with mucous membrane; the Eustachian tubes (*see* The Ear) open into it above the soft palate.

224. Distribution of air and food.—The pharynx receives both the air in breathing and the food in swallowing, and provision has to be made to direct them into their proper channels. In swallowing, it would be fatal if food found its way into the larynx, and most uncomfortable if it went up into the nose. To prevent the passage of food into the larynx, that organ is drawn up as before stated, the epiglottis covering its opening, and to prevent the food from passing up into the nasal cavity the soft palate acts as a valve, being flattened back against the back of the pharynx, the uvula filling up the central groove. The palate drops forward again against the back of the tongue when the food has passed.

During breathing, the muscles of the palate and epiglottis are inactive.

If any foreign body finds its way into the air passages, such as food or water, coughing is at once the result, and is Nature's method of expelling the substance, which would injure the air-passages.

CHAPTER III.

BANDAGES AND BANDAGING.

225. Instruction.—Great economy of time and labour will be effected in imparting instruction in bandaging, by practising one-half of the members of the class at a time in bandaging the other half. This can probably be best carried out by forming up the cadets in two ranks, and then causing the front rank to bandage the rear rank, and vice versa.

226. Bandages.—Bandages are used for many purposes, the chief of which are to fix splints or dressings, to apply pressure to a part, and to support the circulation. They may be divided into three classes, viz., triangular, roller, and special.

Triangular Bandages.

227. Description.—Triangular bandages, used chiefly on field service, are made by cutting pieces of calico or linen, 38 inches square, diagonally into halves; each half then forms a triangular bandage. Of the three borders of the bandage, the longest is called the lower border, and the two others the side-borders. Of the three corners, the upper one, opposite the lower border, is called the point, and the remaining corners the ends.

Stowage.—To fold the bandage for stowage, it should be folded perpendicularly down the centre, placing the two ends together, the right end on the left ; then the ends and the point should be brought to the centre of the lower border, thus forming a square ; fold in half from right to left, and in half again from above downwards, twice.

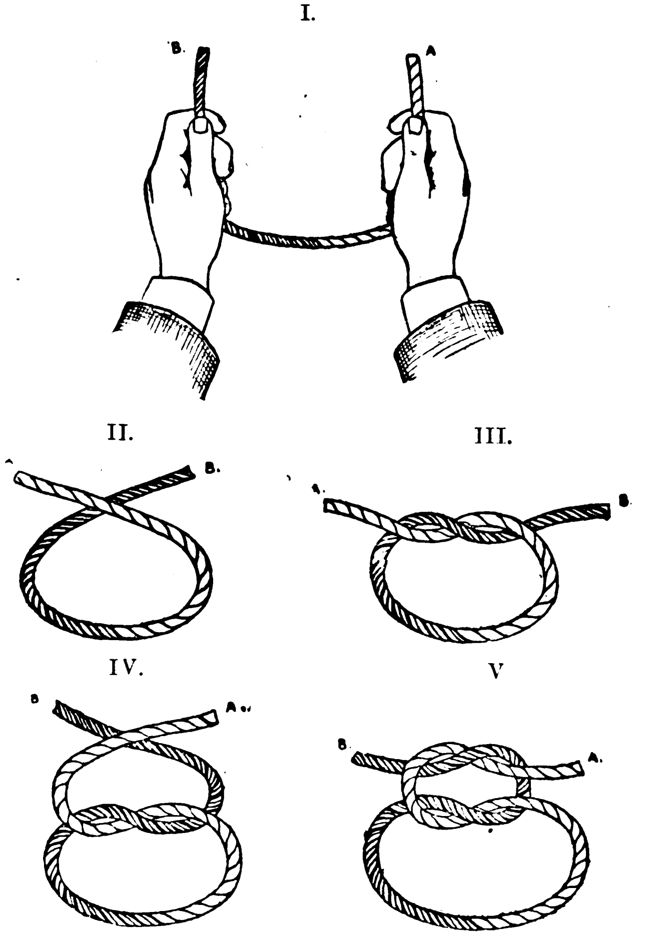


FIG. 85.—HOW TO TIE A "REEF-KNOT."

Three modes of application.—The bandage is applied as (*a*) a whole-cloth, (*b*) broad-fold, (*c*) narrow-fold. The whole-cloth is the bandage spread out to its full extent. The broad-fold is made from the whole-cloth by carrying the point to the centre of the lower border, and then folding the bandage again in the same direction. The narrow-fold is made by folding the broad-fold once lengthwise.

228. Reef-knots.—In every case where a knot has to be tied, a reef-knot will be used, the formation of which is best explained by the accompanying diagrams showing how to make it (Fig. 85) and how not to make it (Fig. 86).

I. II.

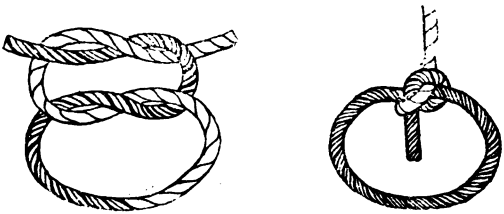


FIG. 86.—THE "GRANNY" KNOT.

229. Application of bandage.—(1) *To bandage top of head.*—Take a whole-cloth, lay the centre on the top of the head, the lower border lying along the forehead just above the eyebrows : fold in the edge, pass the end round behind, leaving the ears free ; cross below the occipital protuberance over the point of the bandage bring the ends to the front again, and knot off on the centre of the forehead. Place the hand on the top of the head to steady the dressing, draw the point down to tighten and fit the bandage to the head, then turn it up and pin off on the top.

(2) *Side of head.*—Place the centre of a narrow-fold over the dressing, pass the ends horizontally round the head, cross and knot off over the dressing.

(3) *Both eyes.*—Place the centre of a broad-fold between the eys, carry the ends backwards, cross and knot off in front.

(4) *One eye.*—Place the centre of a narrow-fold over the injured eye, pass one end obliquely upwards over the forehead, the other downwards across the ear ; cross below the bump at back of head and knot off above the eye-brow on injured side.

(5) *Chin and side of face.*—Place the centre of a narrow-fold under the chin, pass the ends upwards and knot off over the top of head, tucking in the ends.

(6) *Neck.*—Place the centre of a narrow-fold over the dressing, cross the ends, bring back and knot off over the wound.

(7) *Chest*—Apply the centre of a broad-fold over the dressing, pass the ends round, and knot off on the other side, leaving a long

end ; take a narrow-fold, tie to long end, bring it over the shoulder, and pin off to broad-fold over the dressing.

(8) *Abdomen.*—Place the centre of a broad-fold over the wound and knot off on the side.

FIG. 87.—GREATER ARM-SLING.

(9) *To apply the greater arm-sling.*—Take a whole-cloth, throw one end over the shoulder on the sound side, carry round the neck so as to lie over the opposite shoulder ; place the point behind the elbow of the injured arm, allowing the other end to fall down in front of the patient ; bend the injured arm carefully, and place it across the chest on the middle of the bandage, thumb pointing towards the chin ; bring up the lower end in front of the forearm and knot off to the end lying over the shoulder on the injured side ; draw the point foward round the elbow and pin off.

(10) *In broken collar-bone.*—There is one exception to the above method of applying the greater arm-sling, viz., in fracture of the clavicle, where it is not advisable to allow anything to press on the injured bone. To avoid this, the lower end, which is brought up in front of the forearm, should be passed between the arm and the side of the injured shoulder and knotted off to the upper end behind the neck (Fig. 88).

The triangular bandage may be also used to secure the arm temporarily in cases of fractured clavicle. Having placed a small pad in the arm-pit, apply the centre of a narrow-fold bandage to the outer surface of the arm of the injured side, and carry the front-end horizontally across the chest ; bring the back-end forwards between the arm and chest (on the injured side), over the upper margin and front of the horizontal end, then pass it upwards and backwards through the loop thus formed to the back of the chest, and exercise steady traction, so as to draw the arm backwards ; then secure the two ends on the opposite side of the chest. The arm-sling depicted in Fig. 87 can then be applied.

Instead of triangular bandages an ordinary roller bandage may be used, taking care to place a pad between the upper arm and the chest, to draw the upper arm well back, and to support the elbow, as shown in Fig. 89.

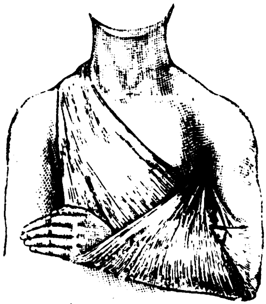


FIG. 88.—ARM-SLING FOR FRACTURED COLLAR-BONE (CLAVICLE).

(11) *To apply the lesser arm-sling.*—Take a broad-fold, place one end over the shoulder on the sound side, carry it round the back of the neck so as to lie over the opposite shoulder, allowing the other end to fall down ; bend the arm carefully and place the wrist across the middle of the bandage with the hand a little higher than the elbow, bring up the lower end and knot off to the upper end over the shoulder on the injured side.

(12) *To bandage the shoulder.*—Take the centre of a whole-cloth on the top of the shoulder, point upwards, the lower border lying

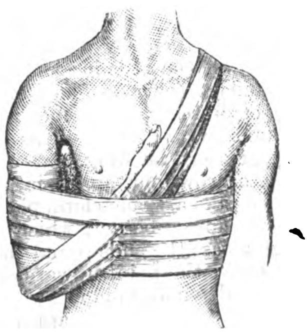


FIG. 89.—ROLLER BANDAGE FOR FRACTURED COLLAR-BONE.

across the middle of the arm. Fold in the lower border, carry the ends round the arm, cross them and knot off on the outer side

Apply the lesser arm-sling, draw the point of the first bandage under the arm-sling, fold it back on itself and pin off over the shoulder.

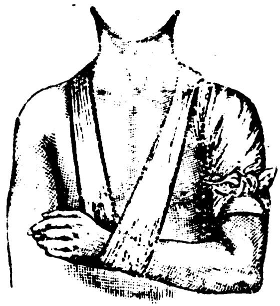


Fig. 90.—Shoulder Bandage and Lesser Arm-sling.

(13) *Elbow.*—Place the centre of a whole-cloth over the back of the bent elbow, point upwards, turn in the lower border, pass the ends round the forearm, cross them in front, pass up round the arm, cross behind and knot off in front. Tighten the bandage by drawing on the point, which is then brought down and pinned off. Apply greater arm-sling.

(14) *Hand.*—Take a whole-cloth, place the hand palm downward on the centre of the bandage, fingers towards the point, bring the point over the back of the hand to the wrist, pass the ends round the wrist, crossing them over the point which is then folded towards the fingers and covered by another turn of the bandage round the wrist. Knot off the ends in front of the wrist.

Or a figure-of-8 bandage (narrow-folded) may be used. Place centre of bandage over dressing, bring ends round to opposite side of hand, cross and take two or three turns round the wrist and knot off. Apply the greater arm-sling.

(15) *Hip.*—Take a narrow-fold, apply it round the waist and knot off in front; then take a whole-cloth, place the centre over the hip, point upwards, the lower border, which should be folded in, lying across the thigh; pass the ends round the thigh and knot off on the outer side. Draw the point upwards beneath the bandage round the waist, turn it down and pin off.

(16) *Knee.*—Keep the leg straight, apply a broad-fold, cross behind and knot off in front below the knee-cap.

(17) *Foot.*—Place the sole of the foot on the centre of a whole-cloth, toes towards the point; turn the point upwards over the instep, take one of the ends in each hand close up to the foot, bring them forward, cross them over the instep covering the point.

Draw the point upwards to tighten the bandage and fold it towards the toes. Carry the ends back round the ankle, cross them behind catching the lower border of the bandage. Bring the ends forward, cross them again over the instep, covering the point, carry them beneath the foot and knot off on the inner side.

(18) *Other part of limbs.*—When applied to any other part of the limbs, a broad-fold is used, the centre of the bandage being placed over the dressing, the ends passed round the limb and knotted off over the wound.

(19) *Perinæum and lower part of abdomen.*—Take a whole-cloth, lower border uppermost, pass the ends round the waist immediately above the hips, and knot off behind leaving one long end; pass the point between the legs, draw it upwards and knot off to the long end behind.

Another method:—Apply a narrow-fold bandage round the waist; pass the end of a second bandage, similarly folded, beneath the waist-bandage at the centre of the back, fold over and secure with safety-pin; bring the other end forward between the thighs up to the waist bandage in front, pass beneath, turn over and secure with safety-pin. This forms a modified T-bandage.

(20) *To fix splints.*—Take a narrow-fold bandage, double it upon itself and place the loop thus formed upon the splint on the outer side of the limb; pass the free ends round the limb from without inwards, and one of them through the loop; tighten the bandage by steadily drawing on the two ends and then knot them in the usual way.

Roller Bandages.

230. Varieties.—Roller bandages are made of calico, linen, flannel, loose-woven material, gauze impregnated with some antiseptic or of elastic webbing. The rollers ordinarily in use for bandaging the head or limbs are made of loose-woven material. Flannel bandages are used for special purposes, for warmth, or after inunctions. Loose-woven bandages are used with plaster of Paris. Gauze bandages are used in antiseptic dressings. Elastic web bandages are used to support the circulation, or exercise pressure on a limb.

231. Sizes.—Roller bandages consist of long strips, varying in length and width according to the part to which they are to be applied, thus:—For the head and upper limbs, 2½ inches wide, and from 3 to 6 yards long; for the fingers, ¾-inch wide, and 1 yard long; for the trunk and lower limbs, 3 or more inches wide, and 6 to 8 or more yards long.

They are tightly rolled on themselves in a compact, cylindrical form ready for use.

232. Instruction in rolling.—The class will first be instructed in the proper methods of rolling a bandage, single and double-headed, and at the conclusion of the exercises the bandages will invariably be inspected, to see that each man hands his in properly rolled.

233. Application of Bandage.—To apply the bandage, the operator stands or sits opposite the patient. The limb is placed in the position it is to occupy when bandaged, and care must be taken that the bandage is not put on so tightly as to cause discomfort, or swelling of the limb below; a bandage too tightly applied may produce gangrene of the limb, by cutting off its blood supply. If, on squeezing the tips of the fingers or toes of the bandaged limb, it is observed that the colour returns much more slowly than when this is done on the unbandaged limb, it may be assumed that the bandage is too tight.

The roller is taken in the right hand when bandaging the left limbs, and in the left hand when bandaging the right. The outer surface of the bandage is applied to the inner side of the wrist or ankle, and two turns taken straight round the limb from its inner to its outer side, to fix it.

(1) *Simple spirals.*—From this point the bandage may be taken up the limb in simple spirals, that is, evenly put-on turns of the bandage, each overlapping for one-third the width of the bandage below, taking care to have the lower edges of the turns of bandage parallel with each other.

(2) *Reverse spirals.*—When the swell of the limb is reached, the edges can no longer be maintained parallel, the bandage will not lie evenly, and gaps occur between the turns if the simple spiral is used. It therefore becomes necessary to use the reverse

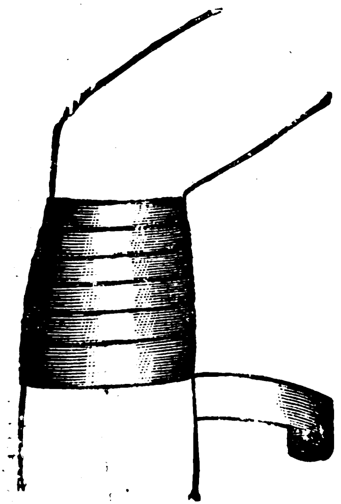


FIG. 91.—SIMPLE SPIRAL.

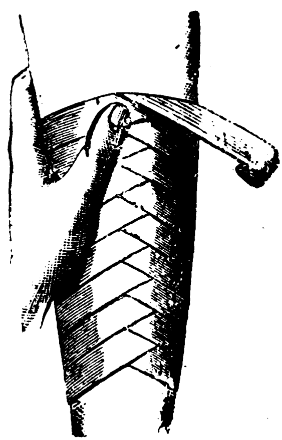


FIG. 92.—REVERSE SPIRAL.

To make the reverse, the thumb of the disengaged hand is placed on the lower border of the bandage on the outer side of the limb, the

bandage is slackened and turned over, reversed downwards, and passed round the limb to the opposite side, its lower edge parallel with that of the turn below. On reaching the outer side the reverse is again made, and so on up to the joint. The angles formed by the successive reverses must be kept in a straight line.

(3) *Figure-of-8.*—On reaching the joint, neither the spiral or reverse will lie evenly, so that the figure-of-8 has to be resorted to. This, as its name implies, is applied by passing the roller obliquely round, alternately upwards and downwards, the turns resembling the figure 8, each figure overlapping the one below by one-third the width of the bandage. The crossings of the figures should be kept in the same line as the reverses below.

(4) *Removal of bandage.*—To remove a bandage it should be unrolled from the top, and the slack gathered into a ball and passed from hand to hand round the limb.

(5) *To bandage a finger.*—Take two turns round the wrist, carry the bandage across the back of the hand to the root of the injured finger, up the finger by an open spiral to the top, whence it is brought by an evenly-laid close spiral to the root; then across the back of the hand to the opposite side of the wrist from that which it started from, round the wrist once or twice and pinned off.

(6) *To bandage the hand or foot.*—Two turns are taken round the wrist or ankle, the bandage carried across the hand or foot to the opposite side, passed across the palm or sole and brought back to the opposite side of the wrist or ankle, over the back of the hand or foot, thus forming a figure-of-8, which may be repeated as often as required.

(7) *To bandage the chest.*—A roller 6 inches wide and from 6 to 8 yards long is used. It is applied from below upwards, in a single spiral, each spiral overlapping the one below for one-half its breadth. On completing the last spiral, the bandage is pinned off behind, leaving about a yard and a half free; this end is brought over one shoulder as a brace, carried obliquely down over the bandage in front to the lowest turn, to which, as well as to the upper turns, it is fastened, thus preventing the bandage from slipping down.

(8) *To bandage the abdomen.*—A bandage to the abdomen is similarly applied to that for the chest, except that it may be put on from above downwards, and that it is kept in position by the free end being carried from behind forward between the thighs and fastened in front.

(9) *To bandage the head.*—To keep a dressing on an ordinary wound of the head a few circular turns of a bandage are sufficient.

The knotted bandage.—To exert pressure on a graduated compress applied over a bleeding wound the knotted bandage is used. This is made with a single-headed bandage. The bandage should be unrolled for about a foot, and the end held in the left hand, which is kept close to the temple, the roller is then carried round the forehead and occiput, so that it comes back to the unrolled end at the wound. At this point the roller is twisted round sharply and

then carried down below the chin and over the vertex. On coming to the temple again the same twist is made, and the roller is once more passed round horizontally; when sufficient pressure is obtained the bandage is fixed by knotting the two ends together.

(10) *To bandage the groin, shoulder, or thumb.—The spica bandage:*—A roller bandage may be applied to the groin, shoulder, or thumb in the following manner, which is known as the spica bandage.

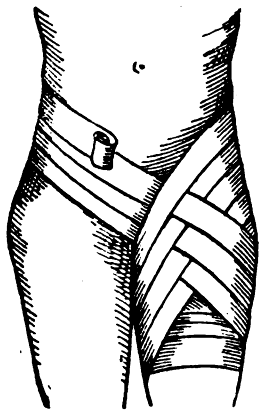


FIG. 93.—SPICA BANDAGE.

It is made by applying the bandage in a series of figure-of-8 turns, overlapping from below up. Take two turns of a single-headed roller round the thigh from within outwards as a point of attachment; carry the bandage upward over the groin above the hip, and round the back to the opposite hip, then across in front of the abdomen, passing round the other side of the thigh and upwards between the thighs to complete the figure-of-8.

The turns are to be repeated as often as necessary.

SPECIAL BANDAGES.

234. Varieties.—(1) *The T-bandage.*—The T-bandage is specially prepared by taking a piece of bandage 3 inches wide and 1½ yards long and sewing it to another similar strip 1 yard long, so as to form a T, the free end of the short portion of the T being split sufficiently to enable one piece to be brought up on each side of the scrotum. It is applied by passing the long strips round the hips so that the attached part is at the sacrum; pin off in front. Bring up the short piece between the thighs, and fasten to the first piece in front. It is used to keep a dressing on the perinæum.

(2) *The four-tailed bandage.*—To prepare the four-tailed bandage, take a yard and a half of 3-inch roller bandage, make a slit in its

centre about 3 inches long, and then slit up the ends so as to leave 6 inches in the centre. In applying it, place the central slit on the point of the chin, tie the two upper tails behind the neck, and the two lower tails on the top of the head; the ends of the upper and lower tails should then be tied together behind the head

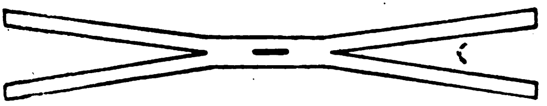


FIG. 94.—FOUR-TAILED BANDAGE.

to prevent the bandage slipping forward. It is used for fracture of the lower jaw, or to retain a dressing on the chin.

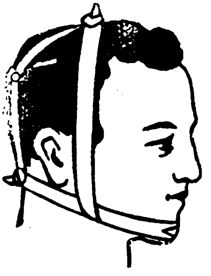


FIG. 95.—FOUR-TAILED BANDAGE (SIDE VIEW).

CHAPTER IV.

WOUNDS.

235. Definition.—A wound may be defined as the forcible solution of continuity of any of the tissues of the body; but the term is more commonly limited to injuries of the soft parts, involving the skin or mucous membrane.

Injuries in which the skin is not involved, and in which the deeper structures, such as bones and ligaments, &c., do not participate are usually spoken of as contusions. Therefore wounds may be described as (1) subcutaneous, *i.e.*, contusions, (2) open.

236. Classification.—Open wounds are usually classified under the following headings:—

(1) *Incised.*—These wounds are made by sharp-cutting instruments, such as a knife, razor, or a sharp sword. They have clean-cut edges, and their length is usually greater than their depth. They

frequently bleed freely, because the vessels are cleanly divided. Bruising of the margins of the incision is absent, and, when properly treated, they generally heal rapidly, leaving simply a line-like scar.

(2) *Lacerated.*—Such injuries are caused by blunt instruments, by machinery, by the wheels of vehicles, or by fragments (metal, glass, &c.).

As the name implies, these wounds usually have ragged edges, and there may be actual loss of substance. They do not as a rule bleed much, because the vessels are torn rather than cleanly divided. Bruising of the margins of the wound may occur, and they do not usually heal so rapidly as incised wounds, and the resulting scars are more marked.

(3) *Punctured wounds and stabs.*—They may be produced by any form of penetrating instrument, from a hat-pin or needle to a sword or bayonet.

The wound is deep and narrow. The skin-wound may in itself be insignificant, but the chief danger of this class of wound is due to the liability of the deeper structures being injured; thus, blood-vessels and nerves may be divided, or the abdominal or thoracic contents injured. They do not usually bleed more externally, but may give rise to serious internal hæmorrhage. When the inflicting instrument is clean, they frequently heal without trouble.

(4) *Contused wounds.*—These are usually caused by injuries from blunt instruments, such as a stone or kick from a boot. The edges are always more or less bruised. Contused and lacerated wounds are practically the same.

(5) *Poisoned wounds.*—By these are meant any of the above class of wounds which have become infected with septic matter, that is to say, germs. They are of a serious nature, as the germs growing in the wounds produce poisonous substances, which are absorbed into the body and produce constitutional symptoms, such as fever, &c.; moreover, if unchecked, blood-poisoning may be set up and death result. The great importance of keeping all wounds aseptic (or germ-free) must therefore be obvious.

Snake bite, &c.—Under poisoned wounds may be included special wounds, such as the bites from poisonous snakes and the stings of insects; wounds from poisoned arrows or spears must also be mentioned.

In bites from poisonous snakes the poison is injected into the wounds at the moment they are made. They are very dangerous, because the poison rapidly reaches the blood, often causing the death of the patient in a very short time.

Treatment of snake-bite.—It is most important to endeavour to allay the anxiety of the patient. The *first* thing to do is to prevent the poison from reaching the heart through the veins. This is done by immediately tying a piece of string, or a strong strip of shirt or handkerchief, very tightly round the limb some distance above the wound, between it and the heart, so that the part below is strangled. *Next*, if any brandy or other stimulant be at hand, give a good dose, as the snake-poison has the effect of stopping the circulation.

Then, if possible, cut freely into the wound and encourage bleeding, and until this has been thoroughly done do not take off the band.

If permanganate of potash crystals are available, make a cross-shaped incision over the bite and rub some of the crystals in thoroughly.

If the breathing is bad or has stopped, use artificial respiration.

Should the wound be in a part of the body where a band cannot be placed, then at once make a crucial incision to encourage it to bleed, and give stimulants.

Treatment of stings of venomous insects.—The stings of bees, wasps, hornets, &c., should, if found, be removed; ammonia, or bicarbonate of soda, if available, should be applied.

CHAPTER V.

THE DRESSING AND HEALING OF WOUNDS (including the first field dressing).

237. General remarks.—Absolute cleanliness in the dressing of wounds is imperative. By absolute cleanliness is meant *surgical cleanliness*, and this means much more than ordinary cleanliness.

We have seen in the preceding chapter that poisoned wounds are caused by their becoming infected with germs, and a poisoned wound may lead to the death of a patient.

The hands are great carriers of germs, and so may easily infect a clean wound.

A dresser should take the utmost care of his hands, especially as regards the nails and the folds of skin surrounding them. This care of the hands should be a daily duty.

238. Rules to be followed in applying dressings.—(1) Never begin to change a dressing until everything that is likely to be required for the new dressing is ready close to hand.

(2) Arrange the bed-clothes so that no part of them can touch the wounded area; the bedding, &c., should be protected from damp, &c., by means of jaconet or mackintosh.

(3) Remove the bandages, but do not touch the actual dressing at present.

(4) Scrub your hands most thoroughly with soap and a stiff nail-brush which has been soaked in antiseptic solution, or preferably, previously boiled.

(5) Rinse off the soap, and, without drying your hands, soak them for some minutes in antiseptic solution.

(6) Having thus cleaned your hands as thoroughly as possible, do not on any account allow them to touch anything such as your clothing, your face, or the patient's bedding or person. Do not dry them unless a sterilized towel is available to dry them on

(7) Never touch either dressings or wound with the fingers: use a pair of sterilized forceps instead.

(8) Remove the old dressing with the forceps, having first loosened it, if it has stuck, with warm antiseptic solution. Be careful to wipe from the wound outwards, so as not to carry germs from the surrounding skin into the wound.

(9) Place the fresh, sterilized dressing gently in position with the forceps and then re-bandage the wounded area.

(10) Before dressing any wound or assisting at an operation which might produce infection, it is advisable to protect any cuts or scratches on the hands, covering them with a couple of layers of gauze and painting that over with collodion, so as to make a waterproof coating.

(11) If the necessary means of purifying the wound are not at hand, do not attempt to wash it or wipe its surroundings; simply apply a dry, antiseptic dressing.

(12) All old dressings should be at once removed and destroyed, preferably by burning.

239. First field dressing.—A field dressing forms a component part of every British soldier's kit on active service, so as to be available, at all times and in all places, as a first dressing for wounds.

The field dressing, pattern 1911, consists of an outer packet of sewn khaki cotton cloth, containing two small separate dressings, each complete in itself. Each single dressing consists of:—(1) A loose-woven bleached cotton bandage, $2\frac{1}{2}$ yards long by $2\frac{1}{2}$ inches wide; (2) a piece of bleached cotton gauze, 36 inches by 23 inches, weight not less than 260 grains, folded into a pad 4 inches by $3\frac{1}{4}$ inches and stitched to the bandage 18 inches from one end; (3) one safety pin.

The bandage and gauze pad are enclosed in waterproof jaconet, the edges cemented with rubber solution so as to render the packet air-tight, having a portion of one of the corners turned back and not cemented. The pin is wrapped in waxed paper and attached outside the jaconet.

The gauze contains 1 per cent. by weight of sal alembroth and is tinted with aniline blue.

The gauze pad is folded once, so that the bandage lies outside the gauze. The short end of the bandage is folded in plaits; the long end is also folded in plaits for 18 inches from the pad and then loosely rolled for the remainder of its length. The rolled portion of the bandage is secured by a stitch to prevent unrolling.

The contents are compressed so that the outer packet does not exceed $4\frac{1}{4}$ inches in length, $3\frac{1}{8}$ inches in width, and $\frac{7}{8}$ of an inch in thickness.

240. How to apply first field dressing.—In applying the first field dressing the points to be attended to are:—Expose the wound by cutting open the clothing, never by dragging it over the wound. Never wipe the wound or attempt to clean it while on the field. Open the packet, taking care not to drop the contents on the

ground, and not to handle the gauze that will touch the wound. Apply a dressing as directed on the covers, putting the gauze straight on the wound.

For a second wound, use the second dressing as instructed in the directions on the outer cover.

241. Healing of wounds.—The way in which a wound heals is as follows :—

(1) The blood escapes.

(2) The ends of the divided blood-vessels draw back, contract, and clots of blood form in them, thus stopping the bleeding.

(3) The fluid part of the blood continues to ooze out, finally gets jelly-like, and sets, glueing the edges together, a little of the fluid part of the blood which escapes forming a scab or crust on the surface. At no time is there any discharge beyond a small quantity of blood-strained serum in the first twenty-four hours.

(4) New blood-vessels gradually make their way from side to side of the wound, and the circulation is thus restored : new tissue is produced and unites firmly the cut surfaces. At the end of ten days or a fortnight the wound has completely healed, a thin red scar being all that remains of it. This is what happens in a cut when the surfaces of the wound touch one another, and is called "healing by first intention."

When the wound is large and the raw surfaces cannot touch one another, small red, rounded projections, called granulations, grow from the bottom and sides of the wound until it is filled up, and a new skin is gradually formed over them. In the end a scar forms, which, when the wound is quite healed, is slightly drawn in ; this is called "healing by granulation." Wounds which heal by granulation are much more difficult to keep free from infection.

The main object in the dressing of a wound is to protect it from the entry of small bodies, called germs. These not only prevent healing, but lead to the formation of matter, and, possibly, to blood-poisoning. A wound into which these germs have entered is called a septic wound, and the treatment which is directed against these germs is called antiseptic treatment. A wound free from germs is called an aseptic wound.

CHAPTER VI.

ANTISEPTIC TREATMENT OF WOUNDS.

242. Germs.—Germs, sometimes called microbes, and scientifically called bacteria, belong to the vegetable world. They are to be found everywhere, especially in dust or dirt. They are on the skin, in all dressings which are not specially prepared, in clothing, on instruments, and in water which has not been recently boiled. They are extremely small, and cannot be seen by the naked eye. One of them alighting on a wound, where, owing to the warmth and

moisture, it becomes active, can in twenty-four hours produce seventeen millions of like germs. The growth of these germs irritates the wound, causes it to form matter (or to suppurate) and produces poisonous substances, which, being drawn into the blood, cause fever and even blood-poisoning. The wound is then said to become septic or poisoned. The killing of these germs which have already reached a wound, and the cleansing of the hands, skin, instruments, and dressings, constitute the antiseptic treatment of wounds.

243. Antiseptics.—Antiseptics are chemical substances, some of which have the power of killing germs, whilst others are only able to prevent their growth. There are both liquid and solid antiseptics, most of which are dangerous poisons. For dressing wounds and cleansing the hands, &c., they are commonly employed in the form of "lotions" made by dissolving some of the substance selected in water. The strength of the lotion is always known, for instance, 1 in 20, 1 in 40, 1 in 1,000, which means that 1 part of the antiseptic has been mixed with 19, 39, or 999 parts of water respectively.

The following are the antiseptics in common use:—

(1) *Carbolic acid.*—This is, ordinarily, a liquid, and is generally used in the form of a solution or lotion of a strength of 1 in 20, 1 in 40, or 1 in 60. The 1 in 20 lotion is used for disinfecting instruments; 1 in 40 and 1 in 60 may be used for dressing wounds or disinfecting the hands. Solutions stronger than 1 in 20 should not be used for this purpose, as they irritate wounds and make the skin of the hands rough and numb.

(2) *Perchloride of mercury.*—This is a heavy, solid white substance. It is used as solutions varying between 1 in 1,000 and 1 in 10,000, and is a very powerful antiseptic. Steel instruments should not be placed in this lotion, as it turns them black and makes cutting instruments blunt.

(3) *Biniodide of mercury*, employed in the form of 1 in 500 solution in methylated spirit. It is used for purifying the hands or the skin of a patient, before operation.

(4) *Boric or boracic acid* is generally seen as flat, colourless, glistening crystals, or as a white powder. It is used either as the powder or as a lotion made by dissolving the acid in water (as a saturated solution). It is a non-irritating and weak antiseptic.

(5) *Iodoform*, a yellow powder of characteristic and unpleasant odour. It is used for dusting on septic wounds.

(6) *Permanganate of potash* occurs as dark-purple crystals. It is used in solutions of varying strength (generally expressed as grains to the pint). Strong solutions stain the hands brown.

244. Order in which dressings should be done.—Suppose a dresser has in his wards various kinds of wounds, some that are clean, such as operation wounds, and others that are suppurating, and, accordingly, contain germs as explained above. In which order should they be dressed? Clearly, the clean aseptic wounds should be first attended to and after these are all dressed the

suppurating wounds may be done; any other course will lead to infection of the clean wounds from the dirty ones.

An aseptic wound must be kept aseptic by exercising the strictest cleanliness, and a septic wound may, by antiseptic measures, be brought into a healthier condition. These two points should be the aim of every dresser.

245. The necessity of thoroughly cleansing the hands between each dressing must now be obvious; if this be not done, one wound will surely be infected from another. After finishing all the dressings, the hands should be cleansed again; this is for the dresser's own protection, as if omitted he may well infect his own hands through small scratches or un-noted skin abrasions.

246. How antiseptic dressings are used.—The method of using these antiseptic dressings to wounds is as follows:—

(1) *In Hospital*, in the case of an operation, where everything is at hand for thoroughly carrying out the antiseptic treatment, after all blood has been wiped away by means of antiseptic swabs, the edges of the wound are drawn together by the surgeon by means of stitches, a drainage tube, if necessary, having been inserted. Pieces of dry, antiseptic gauze are next placed over the wound, and over the top of these antiseptic wool is laid—much if the wound is large, less if small. Over the wool is placed a bandage to keep the dressing in its place.

(2) Where all precautions as to sterilizing hands, skin, &c., cannot be carried out, it is best not to handle the wound at all, but simply to apply the first field or other dry, antiseptic dressing, taking care to handle it as little as possible, and not to touch with the fingers the part of the dressing which is to come next to the wound.

After having applied the dressing, and splint if necessary, steps may be taken to remove the patient to a place of safety; but there is one exception to this, namely, bullet wounds penetrating the abdomen. Experience has shown that the chance of recovery in these cases depends very largely on the patient not being moved at all, but being treated for a time, if possible, where he has fallen. The reason is that the small-bore bullet makes such a small hole in the intestines that little or none of its contents may escape through it, but if the patient be moved, the contents of the gut are much more likely to escape, and set up fatal inflammation. Starvation is the best treatment, not even water being given. Dress the wounds, disturb the patient as little as possible, erect an improvised shelter for him, remove or empty his water-bottle, impress upon him the importance of lying absolutely still, and leave him lying there until a medical officer can see him.

247. Dressings.—Materials used for dressings must be sterilized previously to use. In the case of dry antiseptic dressings such as gauze or wool, these have been specially prepared by being saturated in antiseptic solution, then dried, and afterwards wrapped up in waterproof paper, which has also been sterilized. They are done up in small packages, which can be considered safe for use in the

field provided they have been freshly opened. The materials for stitches and drainage tubes have also been sterilized, and are usually kept ready for use in an antiseptic fluid in closed glass bottles or tubes.

248. Trays and instruments.—All boxes, trays, basins, &c., used for holding dressings or instruments are made of some hard, smooth material, such as glass, china, or vulcanite, and are sterilized by heat before and after use. Instruments such as scissors, forceps, &c., are sometimes so made as to be able to be taken to pieces, and they, as well as knives, are made as smooth as possible, without crevices, so that they can be easily cleaned and do not harbour germs.

249. Antiseptic baths and fomentations.—When a wound has become infected with germs and is inflamed and discharging, it is usual to treat it with antiseptic baths or antiseptic fomentations. Boric acid is the usual antiseptic in such cases. An antiseptic bath consists of boric acid dissolved in warm water (strength, 5 grains to one ounce of water). The limb, or other part, is held in a special vessel containing this warm lotion for such a length of time as may be directed.

An antiseptic fomentation is made in exactly the same way as any other fomentation, except that several folds of boric lint are used instead of the ordinary fomentation-flannel or spongiopiline.

CHAPTER VII.

BLEEDING OR HÆMORRHAGE.

250. Varieties.—Bleeding or hæmorrhage occurs when any portion of the system of blood-vessels gives way, or is opened into by injury or disease.

There are three varieties of hæmorrhage: (*a*) arterial, (*b*) venous, and (*c*) capillary.

These three varieties may furthermore occur (1) externally, when the blood can be seen escaping, such as from a cut; (2) internally, when the blood escapes in the tissues or organs of the body and cannot be seen. This variety may be recognized by the symptoms of the patient, as will be subsequently described. Bleeding in moderate quantity into the tissue of the body is often spoke of as an "extravasation."

INTERNAL HÆMORRHAGE.

251. This, as the name implies, is bleeding from a vessel or vessels inside one of the cavities of the body, *e.g.*, chest, abdomen or skull. The condition is one which can only be recognized by the symptoms presented by the sufferer, no blood being visible as in the case of external hæmorrhage.

Internal hæmorrhage occurs as the result of injury or disease.

252. Symptoms.—The symptoms of internal hæmorrhage are as follows:—Great prostration and weakness. The surface of the body is blanched and white. The lips lose their colour, becoming ashy-grey. A cold clammy sweat breaks out on the patient's forehead, and his features assume an aspect of intense anxiety. His breathing becomes shallow, hurried, and sometimes laboured. At times he yawns and sighs. His pulse is weak and may be imperceptible. Later the patient gasps for air and struggles to obtain it, gradually becomes weaker and unconsciousness sets in.

253. Treatment.—Send for a surgeon. Try and ascertain the cause of the bleeding. If from disease of, or injury to, any part of the body where ice can be applied, at once apply it. Loosen anything tight about the neck or body. Give small pieces of ice to suck. Do not give stimulants. Raise the foot of the bed three or four inches from the ground. Apply hot-water bottles to the patient's feet. Keep him *absolutely quiet*. Avoid all conversation with him. Try and gently restrain him should he become restless. Do everything to allay anxiety should he become nervous about his condition, as this is a most important duty in connection with the treatment of these cases.

254. Treatment of an extravasation.—This is generally seen in the form of a bruise, or black eye, &c. The treatment consists simply of rest and the application of soothing lotions.

External Hæmorrhage.

255. Arterial hæmorrhage.—In arterial hæmorrhage the blood escapes from the arteries. It may be known by (1) the blood escaping in jets or spurts, because it is pumped out by the heart; (2) its bright red colour; (3) that it may be stopped by pressing on the artery between the wound and the heart.

256. Venous hæmorrhage.—In this case the blood escapes from the veins. It may be known by (1) the blood being of a dark, purplish-red colour; (2) its flowing in a continual stream and not escaping in spurts; (3) that pressure applied on the side of the wound furthest from the heart stops it, while pressure applied between the wound and the heart does not do so. A dependent position, muscular exertion or straining, or any obstruction to the veins above a wound, greatly increases venous bleeding. Hence it is much greater after accidents than at operations.

257. Although the above account of arterial and venous hæmorrhage gives the usual signs by which they may be distinguished, certain exceptions may occur. In some instances arterial blood may appear as venous; for example, when it comes from the bottom of a deep and narrow wound, it may flow continually instead of in spurts; or when a patient is partly suffocated it may become of a dark colour. On the other hand, venous blood exposed to air in its passage from a deep wound may, owing to its taking up oxygen, become bright and red in colour.

258. Capillary hæmorrhage.—The blood escapes from the capillaries, and oozes from all parts of the wound, trickling down to the deeper parts, where it forms a little pool.

259. Occurrence of hæmorrhage.—Hæmorrhage may occur as (1) primary, (2) reactionary, and (3) secondary.

(1) *Primary hæmorrhage.*—Is that which occurs at the time when the artery is wounded.

(2) *Reactionary hæmorrhage.*—Is that which occurs after the primary hæmorrhage has ceased, and within twenty-four hours of the injury or operation. It appears when the patient is recovering from the shock of the injury.

(3) *Secondary hæmorrhage.*—Is that which occurs any time after the first twenty-four hours following an injury or operation, but seldom before about ten days or a fortnight afterwards. It is now rare because its chief cause (septic infection of the wound) is now also rare.

260. Arrest of external hæmorrhage.—The means of temporarily arresting external hæmorrhage until more permanent means can be resorted to by the surgeon are (1) pressure, (2) application of heat or cold, and (3) position of the patient.

(1) *Pressure.*—If the bleeding point be within reach, hæmorrhage need cause no alarm, as pressure will control it, however big the vessel may be.

It may be applied:—(*a*) Directly on the bleeding point, if necessary by means of the finger or thumb (digital compression); but preferably by plugging the wound with a piece of antiseptic gauze. (*b*) Close to the wound, between it and the heart (if the bleeding is from an artery); or below the wound, that is on the side distant from the heart (if from a vein). It may be applied by the finger, or, in case of the limbs, by means of a tourniquet. It should be made in such a direction as to press the vessel against some resisting structure, such as a bone. (*c*) In bleeding below the knee or elbow, pressure may be applied by placing a pad in the bend of the joint and flexing the limb.

(2) *Heat or cold.*—Of these, heat is the more effective, but neither are so certain as pressure properly applied. Heat may be applied by means of hot water at a temperature of from 140 to 160 degrees Fahrenheit, that is to say, rather hotter than the hand can comfortably bear. Warm water is worse than useless, as it tends to increase rather than diminish the bleeding. Cold water is not so effectual as hot; it is also liable to increase shock.

(3) *Position of the patient.*—This is often of great importance. Rest, and absolute rest, is essential. Lay the patient down, and try to keep him as quiet as possible and to allay his alarm. While keeping the patient lying perfectly still, if the bleeding is from a limb, raise it and keep it elevated.

As a rule, pressure combined with elevation (in the case of a limb) will always check the bleeding until means can be obtained for permanently arresting it.

THE ARTERIES OF THE BODY

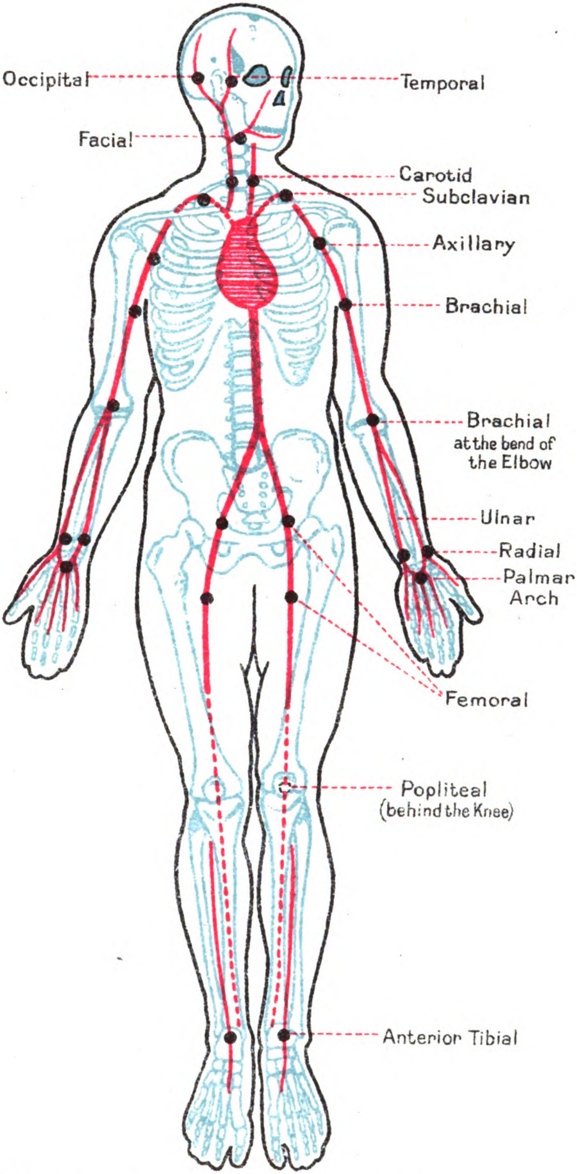


Fig. 96. *The black dots indicate the point where to apply compression.*

The application of styptics (such as perchloride of iron, &c.) to stop bleeding should never be done without orders from a surgeon. Other methods of permanently arresting hæmorrhage, such as tying the vessels, can only be done by him.

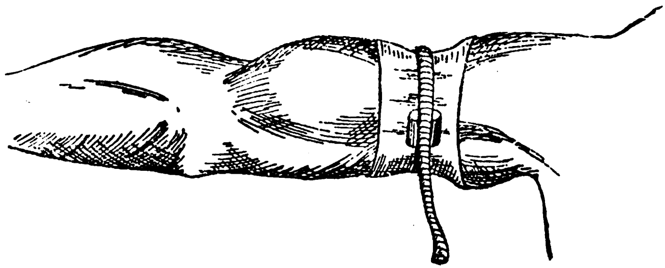


FIG. 97.—COMPRESSION OF THE BRACHIAL ARTERY BY AN ELASTIC TOURNIQUET.

261. Compression by tourniquet.—Compression by means of a tourniquet is only applicable in the case of the arteries of the limbs where the pad takes the place of the thumb and finger as described in digital compression.

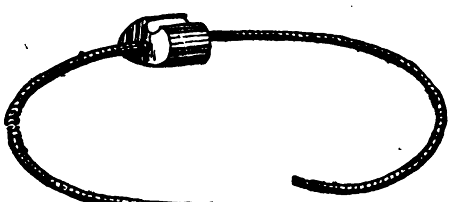


FIG. 98.—ELASTIC TOURNIQUET.

262. Kinds of tourniquets.—There are three kinds of tourniquets in common use—the elastic, the screw, and the field.

(1) *Elastic tourniquet.*—The elastic tourniquet consists of thick, elastic tubing which is wound tightly round the limb, and is then fixed by hooks or other appliances.

(2) *Screw-tourniquet.*—The necessary parts of the screw-tourniquet are a pad, a band, and a means of tightening the band so as to press the pad against the artery and so compress it against the bone.

The pad is placed over the main artery, the strap is passed round the limb and buckled. Care must be taken that the pad does not

shift from its position over the artery. The screw is then turned until the bleeding stops.

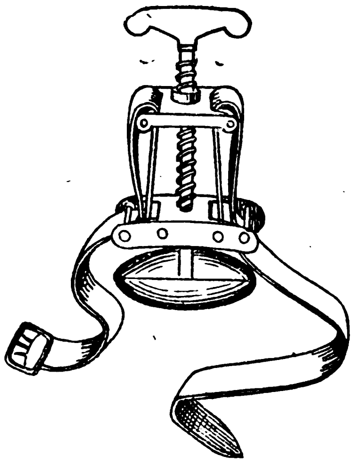


FIG. 99.—SCREW-TOURNIQUET.

(3) *Field tourniquet.*—This consists of a pad fitted to a strap and buckle; it is applied in a similar manner to the screw-tourniquet.

(4) *Improvized tourniquets.*—Place some hard substance or a graduated compress over the trunk of the bleeding vessel. Over this lay the centre of a folded handkerchief or bandage, and tie the ends together on the side of the limb opposite the pad. Then place a stick, or any piece of wood which may be at hand, such as a tent-peg, in the loop thus formed, and twist it until sufficient pressure is made to stop the bleeding. The piece of stick, or whatever is used for tightening the handkerchief or bandage, is kept in position by means of a second handkerchief or bandage, applied below and fastened round the limb. (*See* Figs. 100 and 101.)

The most readily and easily made pad for a tourniquet is obtained by tying a knot in the centre of a pocket-handkerchief or triangular bandage, placing the knot over the bleeding vessel; then pass the ends round the limb and tie them together, and tighten by means of a stick as described above.

In selecting the substance for making a pad, it should be specially kept in mind that it should have a smooth surface and round edges A properly applied compress, which can be quickly made from strips torn from the clothing of the individual under treatment, is preferable to any other form of improvised pad. Experience has

shown that not only does it fulfil the purpose for which it is applied more effectually, but it is less painful than a stone or other hard substance used as a pad. Irregularly shaped stones, or other hard material used as substitutes for a pad, cannot be borne for long owing to the great pain they cause. If a stone or hard substance

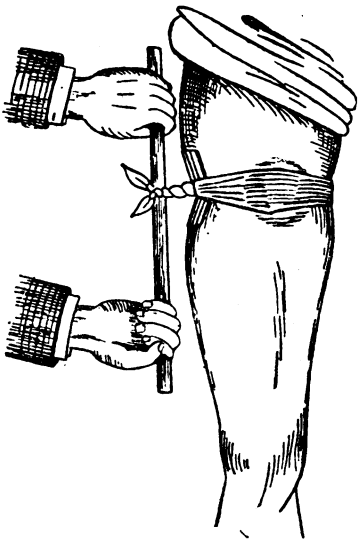


Fig. 100.—Improvized Tourniquet for Compression of Wound of the Femoral Artery.

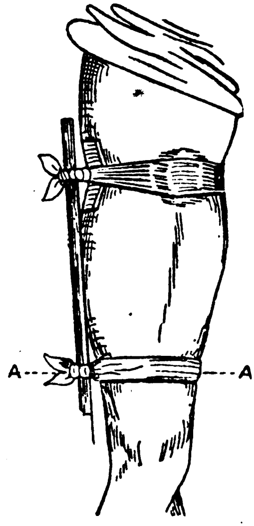


Fig. 101.—The Tourniquet Fixed by a Bandage at "A."

has to be used it should always be carefully wrapped in a handkerchief or bandage before being applied.

The pugarees of helmets, puttees, and the straps and belts of a man's equipment may often be used with success in dealing with the arrest of hæmorrhage.

263. Caution in use of tourniquets.—Digital compression, or compression through a pad of antiseptic material, is greatly to be preferred to compression by tourniquets. Being a mechanical contrivance, it is very difficult to estimate the amount of pressure exerted when using a tourniquet, and it is a good rule only to tighten it *sufficiently to check the hæmorrhage*, and no more. If great care be not taken, serious injury to other structures lying close to the artery (such as nerves and veins) may be done; this may easily lead in the end to the death of the limb below, from

mortification or gangrene. So it may be seen that a patient who, if treated with care, will recover completely, may well, if treated without care, suffer the loss of a limb or even of his life. Too much stress cannot be laid upon this most important point.

264. Arrest of hæmorrhage in special situations.—Digital compression of the following arteries is carried out as below:—

(1) *Common carotid artery.*—The common carotid, lying in the side of the neck, may be compressed against the spine by pressing with the thumb backwards and inwards in the hollow of the neck, formed between the windpipe and the ridge of muscle running from behind the ear to the centre of the breast-bone.

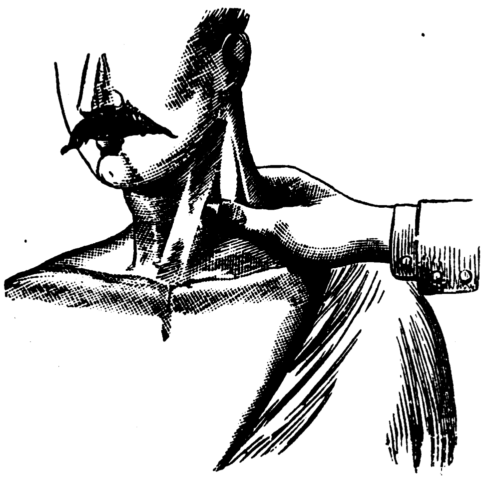


FIG. 102.—DIGITAL COMPRESSION OF THE CAROTID ARTERY AGAINST THE SPINE.

(2) *Subclavian artery.*—The subclavian artery may be compressed at the base of the neck opposite to the centre of the collar-bone. By drawing forward the shoulder, the artery will be more easily reached by the thumb pressing downwards against the first rib behind the clavicle. Compression can also be effected with the handle of a key wrapped in soft cloth, in the same way as with the fingers.

(3) *Axillary artery.*—To compress the axillary artery, raise the arm, place the fingers in the arm-pit and press upwards against the head of the humerus.

The vessels of the upper and lower limbs are those to which, in case of hæmorrhage either from them or their branches, tourniquets and digital compression can best be applied.

Fig. 103.—Digital Compression of the Subclavian Artery Against the First Rib.

(4) *Brachial artery.*—The brachial artery may be compressed with the fingers against the inner side of the middle of the humerus.

The inner seam of the coat-sleeve, or the inner margin of the biceps, may be taken as a rough guide to the course of the artery. Extend the arm at right angles from the body. Then, standing behind the limb, grasp the arm about the middle, the fleshy part of the fingers resting on the inner edge of the biceps muscle, thumb on the outer side of the limb. Compress the artery against the bone sufficient to arrest the hæmorrhage. In practising this method the fact of the artery being properly compressed is evidenced by the

absence of the pulse at the wrist. It can also be compressed by both thumbs as in the case of the femoral artery.

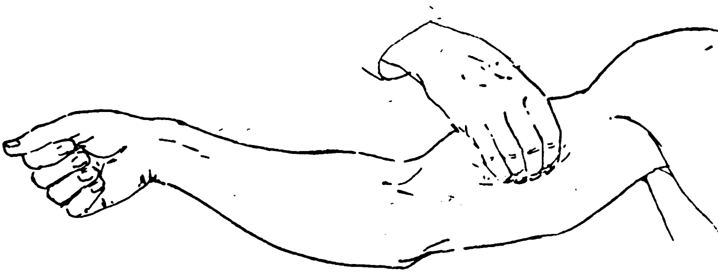


FIG. 104.—DIGITAL COMPRESSION OF THE BRACHIAL-ARTERY AGAINST THE HUMERUS. (BEST METHOD.)

(5) *Radial and ulnar arteries.*—Hæmorrhage from these vessels may be checked either by pressure on the brachial artery or by the flexion-method with a pad in the bend of the elbow, the forearm being kept in position by a bandage passed round the wrist and arm, the limb then being bandaged to the side of the chest.

(6) *Palmar arch.*—The bleeding may be arrested as described above under the last heading. The application of a graduated compress to the palm is not advisable.

(7) *Abdominal aorta.*—The abdominal aorta may be compressed by flexing the thighs on the abdomen, and pressing backwards against the vertebræ at the level of the navel, but slightly to its left.

(8) *Femoral artery.*—The femoral artery runs from the centre of the groin down the inner side of the thigh to the centre of the back of the knee-joint. The artery may be compressed against the hip-bone by pressing at the fold of the groin, or against the upper end of the thigh-bone by pressing backwards and outwards on the line of the artery, some four fingers' breadth below the fold of the groin.

(9) *Arteries of leg and foot.*—Direct pressure on the bleeding point, or in the course of the artery above the wound, should first be tried. If unsuccessful, compress the femoral artery as above described.

(10) *Temporal artery.*—Bleeding occurring from this vessel is best controlled by an antiseptic pad applied directly to the bleeding spot.

(11) *Scalp.*—Hæmorrhage from wounds of the scalp and forehead can be controlled by an antiseptic pad and bandage.

(12) *Tongue.*—Hæmorrhage from the tongue, if the wound is sufficiently far forward to permit of it, can be controlled by pressure with a pad of gauze. If this is not successful, pass the finger to the back of the tongue and press it forwards against the lower jaw-bone.

(13) *Lips.*—Hæmorrhage from the lips can be controlled by a pad in a similar manner, or by grasping the lip on each side of the wound.

Fig. 105.—Digital Compression of the Femoral Artery Against the Femur.

(14) *Cheek.*—Hæmorrhage from the cheek may be controlled by compressing the wound between a pad of gauze placed on the wound and the forefinger, which is placed inside the mouth.

(15) *Throat and Palate.*—Hæmorrhage from the throat or palate can be most readily dealt with by giving ice to suck. Hæmorrhage from the cavity from which a tooth has been recently extracted may be arrested by pressing into it a small plug of antiseptic gauze or wool.

(16) *Nose.*—This is called epistaxis ; it may be treated by making the patient lie down and holding a piece of ice, if available, to the bridge of the nose ; or the patient may be directed to sniff ice-cold water up the nostrils. The application of cold to the nape of the neck is often effectual. Keeping both arms fully extended above the head is also of value.

These methods being unsuccessful, a surgeon should be sent for, as the nasal passages may require to be plugged before the hæmorrhage can be controlled.

(17) *Varicose veins.*—This generally occurs as the result of an ulcer, from the floor of which the blood will be seen to be issuing. Plaçe the patient lying down, and elevate the limb. Apply an antiseptic pad. Bandage the limb above and below the bleeding point. Keep the patient quiet and the limb elevated.

(18) *Hæmoptysis and Hæmatemesis.*—Bleeding from the lungs is known as hæmoptysis. Bleeding from the stomach is known as hæmatemesis.

The following points will help to distinguish them :—

Hæmoptysis.	*Hæmatemesis.*
1. The blood is bright-red in colour.	1. The blood is dark in colour, and may appear like coffee-grounds.
2. It is frothy from being mixed with air.	2. It is not frothy, but may be mixed with particles of food.
3. It is coughed up.	3. It is vomited up.
4. As a rule the patient does not feel sick beforehand.	4. A feeling of sickness is often felt beforehand.
5. The patient is probably suffering from disease or wound of the chest.	5. The patient is probably suffering from disease or wound of the stomach.
	6. Blood may be passed in the motions subsequently.

It must be remembered that blood may be first swallowed and afterwards vomited, so that a patient may vomit blood which has really come from his nose.

CHAPTER VIII.

FRACTURES AND THEIR TREATMENT.

265. Definition and causes.—When a bone is broken it is said to be fractured.

The causes of a fracture may be (1) injury, (2) disease.

The violence may be applied (*a*) directly, or (*b*) indirectly to the bone, or it may be broken by (*c*) muscular action.

Disease of the bone itself may so weaken it, that it breaks much more easily than it naturally would.

266. Fracture by direct violence.—The bone breaks at the spot struck or crushed; the violence may be caused by a kick, the passage of a wheel over the part, &c.

267. Fracture by indirect violence.—The bone does not give way at the point struck, but, owing to the shock being transmitted, it is broken at some distance from the actual seat of violence. As examples may be mentioned the frequency of fractures of the collar-bone from falls on the hand, and fracture of the base of the skull

from a fall from a height on to the feet. In the first instance, the violence is applied to the hand, and the shock travels up the arm to the clavicle and breaks it; and in the second instance the shock is transmitted from the feet, through the legs and spine to the skull.

268. Fracture by muscular action.—This is caused by violent contraction of the muscles. It is not so common a cause of fracture as the above. Fractures of the patella or knee-cap are not uncommonly caused in this way.

269. Varieties.—Fractures are described as (1) simple, (2) compound.

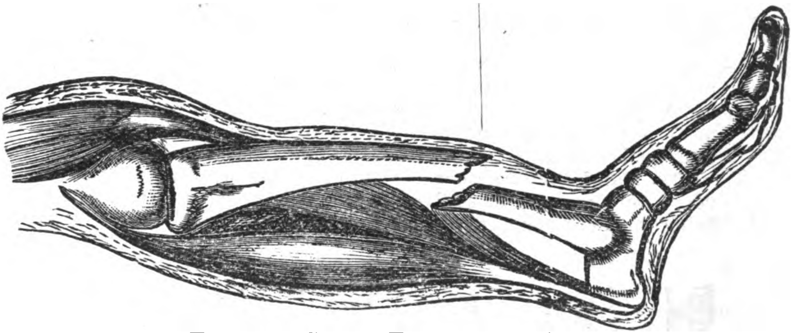


FIG. 106.—SIMPLE FRACTURE OF TIBIA.

(1) *Simple fracture.*—When the skin over the bone is not broken, the fracture is said to be simple.

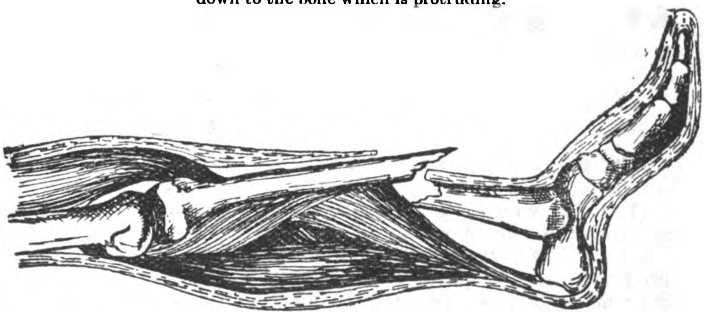


FIG. 107.—COMPOUND FRACTURE OF TIBIA.

(2) *Compound fracture.*—When a wound through the skin and soft parts leads down to the break in the bone, the fracture is said

to be compound. Sometimes, but not always, the bone protrudes through the skin, as in Fig. 107. Compound fractures are much more serious injuries than simple fractures.

270. Complicated fracture.—A fracture (either simple or compound) is said to be complicated when, in addition to the break in the bone, the arteries, veins, or nerves of the limb are injured ; or when the lung or the brain are damaged by a broken rib or skull ; or a fracture may be complicated by a dislocation of the bone in addition.

271. Other forms.—Fractures are further described as :—

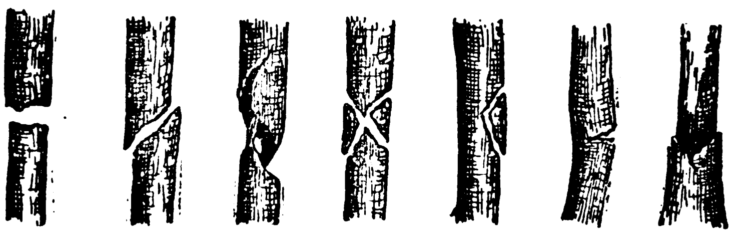
(1) *Complete fractures*, when the bone is broken right across.

(2) *Incomplete* or *greenstick fractures*, when the bone is partially broken or bent. This variety is most commonly seen in children, because their bones are softer than those of adults

(3) *Comminuted fractures*, when the bone is broken in several pieces, or even pulverized.

(4) *Impacted fractures.*—When a bone is broken and one fragment is driven into and firmly fixed in the other fragment, the fracture is said to be "impacted."

272. Line of the fracture.—The line of the break may be transverse, oblique, spiral, stellate, or wedge-shaped, the two latter being commonly seen in gunshot injuries.



Transverse. Oblique, Spiral. Star-shape or stellate. Wedge. Greenstick. Impacted.

FIG. 108.—DIAGRAMS OF FRACTURES.

273. Signs of fracture.—It may be known that a bone is broken by the following signs :—

(1) Pain ; which is generally referred by the patient to the point at which the bone is broken.

(2) Loss of power, *i.e.*, the limb cannot be put to its proper use ; for instance when a leg is broken a man cannot stand upon it ; when an arm is broken the hand cannot be raised to the back of the head.

(3) Alteration in shape ; the limb may be bent, twisted, or shortened, and, when compared with the sound limb, it appears of an unnatural shape.

(4) Unnatural mobility; that is, when the limb is handled (which should not be unnecessarily done), it gives way where, if sound, it would not be movable.

(5) When handled (*see* (4)), there is generally a grating sensation, caused by the broken ends of the bone grating against one another. This is known as "crepitus."

(6) Swelling of the limb is generally present.

(7) The patient may have experienced the sensation of a sudden snap or giving way of the bone.

274. Mode of repair.—The repair (or union as it is called) of a fractured bone is a similar process to that already described under the Healing of Wounds, but it is modified owing to the process taking place in a different kind of tissue. A bone has its blood-vessels just as any other portion of the body; it must not be looked upon as a hard, bloodless structure, but as a portion of the living body which is itself alive. The blood poured out at the time of the injury sets into a jelly-like mass, which in time becomes formed into new bone. This soft mass which is going to become bone, is called "callus," and it surrounds the broken ends of the bone and in hardening holds them firmly together. After the lapse of months a large portion of the callus at first formed becomes absorbed, and in the end, there may be very little trace to be seen where the fracture has been.

In order to allow the process of repair to proceed naturally, it is necessary that the broken ends of the bones remain completely at rest. Nature attempts to ensure this by causing pain when the limb is moved, and to assist Nature, and secure immobility, the surgeon fixes the limb in splints, or takes other steps to prevent the ends of the bones from moving.

The time taken for a fracture to unite firmly depends upon the size of the bone; a finger-bone, for instance, may unite in fourteen days, whereas the thigh-bone may take two months or more.

275. Treatment of doubtful cases.—If in doubt as to whether the bone is really broken, the case must be treated as one of fracture. Handle the limb with the greatest gentleness in order that there may be no risk of further injury to the part, bearing in mind that a simple fracture may easily be converted into the much more serious compound or complicated fracture by rough handling.

276. Early treatment: *Removing the clothing.*—In removing the clothing the greatest gentleness must be used. In the case of a fractured thigh or leg, the outside seam of the trousers should be split right up. Braces must be unfastened all round. There must be no dragging on taking off the clothing. The leg of the cut trousers should then be very carefully drawn to the inside of the injured limb, and the leg of the trousers on the sound limb can then be pulled off. The sock should be cut off, after the boot has been slit up the back-seam, fully unlaced and removed. In fracture of the arm the coat-seam and shirt must be ripped up.

Application of splints.—Apply splints round the limbs, so as to render the fragments immovable. In doing this there need be no

effort made accurately to replace the fractured parts, but merely in a general way to reduce the deformity by first fastening the lower bandage round the carefully-applied splints, pulling gently and slowly in the line of the limb, and then securely fastening the upper bandage. To support the limb effectually the splint should extend beyond the joints above and below the fracture.

277. Splints.—Splints consist of supports made of some unyielding material (wood, iron, perforated zinc, pasteboard, &c.), varying in length, width, and shape with the part to which they are to be applied. Before being applied they should be padded with some soft material, to protect the limb from the hard surface and edges of the splint.

278. Pads for splints.—These are usually made of soft linen or calico stuffed with cotton-wool mixed with tow, or with tow alone. Care must be taken that the pads are quite even, and contain no lumps of tow or wool, which should be well teased out. Pads should be large enough to protect the limb from the edges of the splint. Some splints are covered with jaconet to keep them clean and the pads dry.

Splints are bound to the limb by bandages or tapes, so that when fixed the limb is protected and held firmly in its proper position.

279. Moving a patient.—In moving a patient all disturbance of the limb should be prevented as much as possible. In the upper extremity the arm may be supported in a sling and tied to the side. In the lower extremity the limbs should be tied together at the knees and ankles.

In no case should a man with a broken limb, or supposed broken limb, be moved until splints have been applied.

280. After-treatment.—The subsequent treatment of fractures, that is, the setting of the bones and final application of the splints, is carried out by the surgeon; but it is necessary that men should be familiar with the apparatus in general use in military hospitals, in order that they may render intelligent assistance.

Examples of apparatus are :—Rattan-cane splints for the limbs; japanned iron-wire arm-splints; sheets of perforated zinc, with shears, hammer, anvil and rivets to shape and join them; strips of aluminium made up as splints; plaster of Paris; sheets of pasteboards; and gutta-percha, poroplastic felt, and leather, which have to be cut to shape and softened in water. There are special splints for certain parts of the body :—For the thigh-bone, Liston's long thigh-splint (generally jointed for packing); for the lower part of the thigh-bone, McIntyre's splint; for the leg, the same splint or a metal back splint.

281. Fracture-bed.—For cases of fracture it is necessary that the bed should be even and firm, so that in a case of fractured thigh or leg, for instance, the limb can be kept quite straight and immovable. Boards are also used for this purpose. These can be placed under the limb, leaving the rest of the bed free. A six-foot barrack-table can be used.

282. Sand-bags.—Bags filled with sand are very useful to steady a limb. They are placed on each side to steady it and prevent movement.

283. Danger of tight bandages.—After a splint has been applied, there may be much pain and swelling of the parts, due to the bandages being too tight. The orderly should at once inform the sister or non-commissioned officer.

284. Plaster of Paris splints.—For a plaster of Paris splint there are required: One or two pounds of fresh plaster of Paris, which, after the tin has been opened, should be put on the hob, near the fire, for twenty minutes; one or two flannel bandages; three or four loose-wove or muslin bandages; two clean basins, one for the dry plaster, and the other for cold water; and a newspaper spread under the limb to protect the bedding. Method of applying: The muslin bandages are soaked in water; the flannel bandage is wrapped round the limb, which is then covered with one layer of the wet, muslin bandage; a handful of dry plaster is taken, dipped into the cold water, and smeared on; another bandage is applied, and covered with more plaster and so on. The limb is kept carefully in position till the plaster sets. Salt in the water quickens setting, gum-mucilage delays it. To remove the plaster of Paris from the hands, wash in water to which a little soft sugar has been added.

285. Improvized splints.—In cases of emergency, specially-made splints may not be at hand, and it therefore becomes necessary to contrive an apparatus which shall take their place. Such splints are called improvised splints, and can, with a little ingenuity, be made out of parts of the man's equipment and accoutrements, *e.g.*, rifle, bayonet, scabbard, &c.; padding for the same can be conveniently made out of his clothing. In addition to these ample material for making splints is found around all farm houses, villages, etc., in the shape of the wood from doors, shutters, tables, gates, hurdles, floorings, or provision boxes; also brushwood, telegraph-wire, corrugated-iron, &c., ; while padding for them is usually at hand in the form of corn-sacks, shavings, newspapers, hay, straw, leaves, ferns, and grass. Materials for fastening the splints in position are available in the shape of rifle-slings, straps, belts, braces, boot-laces, &c, ; putties and helmet pugarees form useful bandages, or strips for that purpose can be torn from shirts. The rifle-splint is described in para. 286 (9).

286. Special fractures.—Under this heading only the more common fractures will be discussed.

(1) *Fracture of the spine.*—This injury may result from falling from a height on the back across a bar, or on to uneven ground; or from a fall upon the head. In this fracture the vertebræ are broken and displaced; the spinal cord and nerves are damaged according to the amount of displacement present, the result being complete or partial paralysis of the parts below the seat of fracture.

Treatment.—(*a*) No attempt should be made to move the patient until a medical officer arrives; but,

(*b*) If no surgeon is available within a reasonable time, first aid may be rendered.

(*c*) Some form of support should be passed beneath the patient; for example, a blanket, sheet, roll of canvas, &c., taking care in doing so that the sufferer is disturbed as little as possible, and that he himself makes no attempt to roll over.

(*d*) After this has been done, poles must be fixed on to the support on each side.

(*e*) The patient should then be slowly and with the utmost care placed upon a stretcher, board, gate, &c., and carried, if possible, by four people to the nearest place of shelter, where he should be kept absolutely quiet until the arrival of a surgeon.

(2) *Fracture of the skull.*—The patient may be quite unconscious or only dazed; there may be bleeding from the mouth, ears, or nose.

Treatment.—The patient must be kept absolutely quiet until he can be seen by a surgeon. Stimulants must not be given. Special care should be taken of the ears, &c., so that no dirt or septic matter may get in. This is very important, as bleeding externally means that the fracture is compound, and if septic matter gets in, it may lead to inflammation of the brain. If available, the ears and nostrils should be plugged with pieces of gauze or wool moistened in antiseptic solution.

(3) *Fracture of the pelvis.*—This is nearly always due to severe direct violence, such as the passage of a wheel across the body.

As a rule there is little displacement of the bones; and the treatment consists in keeping the parts at rest by means of a broad bandage.

(4) *Fracture of the lower jaw.*—In addition to the usual signs of fracture the following are often present:—

(*a*) Inability to speak or move the jaw with any degree of freedom.

(*b*) Irregularity of the teeth, noticeable on looking into the mouth, or passing the finger along them.

(*c*) Bleeding from the gums.

) Salivation.

Treatment.—The four-tailed bandage as described under the heading of "Special bandages" should be applied, and the case removed to hospital forthwith.

(5) *Fracture of the ribs.*—When a rib is broken the patient complains of severe pain on taking a long breath, and crepitus may be detected on placing the hand over the injured part. In addition to these signs, when the lung is injured, as is often the case, blood may be coughed up.

Treatment.—Two broad-fold bandages should be applied firmly round the chest, in such a manner that the centre of one bandage is immediately above, and that of the other directly below, the seat of fracture, the upper half of the lower bandage overlapping the lower half of the upper. The bandages should then be tied off on the opposite side of the body to the injury, knots slightly to the front. When the ribs are crushed in and the lung is severely injured, bandages must not be applied to the chest, as great damage may be inflicted by the fragments being still further pushed into the lung. In this case the patient should be laid down, slightly inclined

towards the injured side, all clothing loosened, small pieces of ice should be given to suck, and an ice-bag placed over the injured area. The greater arm-sling should be applied in either case, and the patient removed at once to hospital.

(6) *Fracture of the collar-bone.*—This is caused either by a fall on the shoulder or outstretched hand, or by direct violence applied to the collar-bone itself. The arm on the injured side is helpless; the patient generally supports it at the elbow with his other hand, and the head is inclined towards the injured side. On examining the injured side, a deformity in the line of the collar-bone will be at once apparent, and to this point the patient will refer most of the pain from which he suffers.

Treatment.—After the coat and all necessary clothing has been removed, a pad about the size and thickness of the palm of the hand should be placed in the axilla of the injured side, and the bandages for fractured clavicle should be applied as described under "Bandaging."

(7) *Fracture of the upper arm.*—The upper arm may be broken (*a*) near the shoulder, (*b*) about the centre of the bone, or (*c*) near the elbow-joint. The usual signs of fracture are present.

Treatment.—(*a*) If the fracture is near the shoulder, first a pad should be placed along the inside from the arm-pit to the elbow; then the affected arm should be bandaged to the side by means of a broad-fold bandage, the centre over the centre of the arm and the ends passed round the body and tied on the opposite side. The lesser arm-sling should be applied.

(*b*) If the fracture occurs in the shaft or middle portion of the bone, four short splints must be applied to the arm, in front, behind, and on either side. Care must be taken that the front splint is not too long to prevent easy bending of the elbow, and that the bandages retaining the splints in position are applied above and below (*i.e.*, not over) the seat of the fracture. The lesser arm-sling should be applied.

(*c*) If the arm bone is broken in its lower part near the elbow, the forearm should be bent up, the splint about to be described applied, and the arm supported by the greater arm-sling. Two pieces of moderately thin wood about three inches wide should be taken; one long enough to reach from the arm-pit to the elbow, and the other from the elbow to the finger tips, tied together so as to form a right angle or sort of capital L, and the splint thus formed is to be applied on the inner side of the arm and forearm by means of bandages above and below the fracture. The thumb must be kept pointing upwards. A ready-made angular splint, if available, may of course be used in place of the above.

(8) *Fracture of the forearm.*—One or both bones of the forearm may be broken, the signs of fracture not usually being so evident in the former as in the latter case. There is generally in all cases loss of power and acute pain on moving the limb, and deformity at the seat of fracture. A transverse fracture at the lower end of the radius is known as a "Colles's fracture"; it is very frequently of the impacted variety.

Treatment.—Is the same whether one or both bones are broken. The forearm should be bent at right angles to the arm, keeping the thumb uppermost and the palm of the hand towards the body. Then two broad splints applied on the inner and outer sides of the forearm respectively, the former being long enough to reach from the elbow to the fingers, and the latter from the elbow to the back of the hand. It must be bandaged, if possible, above and below the fracture, steadying the hand by another bandage. Finally the greater arm-sling should be applied.

(9) *Fracture of the thigh-bone.*—The thigh-bone may be broken by direct violence, the bone giving way in this case where the force was applied ; or by indirect violence. There is usually well-marked shortening of the limb, and the foot of the injured side is often turned outwards.

Treatment.—(*a*) The foot of the injured side must be brought into line with the sound side, by gently and steadily pulling upon it. If an assistant is at hand, after the foot has been drawn into its proper place, it should be given to him to keep in position until splints, &c., have been applied ; or, pending the application of splints, the feet may be tied together at the ankles.

(*b*) A splint must be applied on the outer side of the injured limb, long enough to reach from the axilla to beyond the foot. A broom-handle, or any piece of wood long enough, may be used, or a rifle, although short for this purpose, may be used in the special manner to be described under "rifle-splint."

(*c*) A second splint is to be applied on the inside of the fractured thigh reaching from the fork to the knee.

(*d*) The splints must be secured in position by bandages as follows: The first is passed round the chest just below the axillæ, and the second round the pelvis ; both these should be broad-fold bandages. The third and fourth, which are narrow-fold bandages, should be applied round the thigh above and below the fracture, so as to enclose the thigh and both splints. Another bandage should be passed round the leg enclosing the long splint. The ankle fastened to the lower end of the long splint. Finally the injured limb should be bandaged to its fellow.

Rifle-splint.—The following are the rules for the application of a rifle-splint (Fig. 109):—The bolt must be removed and it must be seen that the rifle or magazine contains no cartridges.

A narrow-fold bandage must be placed over the heel plate of the butt in such a way that two-thirds of its length are in what will be the outer side, and one-third on the outer side of the butt ; a half-hitch is to be taken round the butt with the long end, making a half-knot on the outer side above the D for the sling ; the ends tied so as to form a loop about two inches long. This is for the perineal bandage to pass through, and is called the butt-loop.

The magazine should be left in position, the rifle placed along the injured limb, butt toward the arm-pit, magazine uppermost.

A narrow-fold bandage should be placed with its centre over the ankle of the injured limb, the ends passed behind, enclosing muzzle

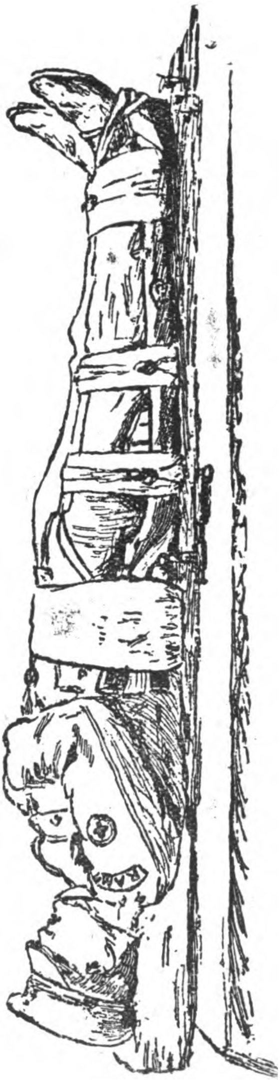


FIG. 109.—RIFLE-SPLINT APPLIED.
(Short rifle (Lee-Enfield) applied.)

of rifle, cross behind. With the outer end a turn should be taken round the muzzle in front of the foresight, bringing both ends up, crossed over instep and tied off on the inside of the foot.

A narrow-fold should be placed with its centre in the fork, one end brought out behind, the other in front of the limb; one end passed through the butt-loop and tied, gradually tightening the knot as the limb is gently drawn to its proper length. Both ends should be passed round the butt and tied off.

Two long splints should be placed one on top and the other along the inner side of the thigh and fixed at each end by a narrow-fold bandage tied off over the rifle; care should be taken that the top splint does not press on the knee-cap.

A broad-fold bandage should be placed with the centre over the butt of the rifle, the ends passed round the body and tied off on the opposite side.

The patient's legs should be tied together by placing the centre of a broad-fold over both ankles, the ends passed behind, crossed, brought up, and tied off on top between the legs.

(10) *Fracture of the knee-cap.*—The knee-cap may be broken by direct violence, such as a fall on the knee; or by muscular action. The fragments will usually be easily detected and are generally well apart. The limb is helpless and the knee joint rapidly swells.

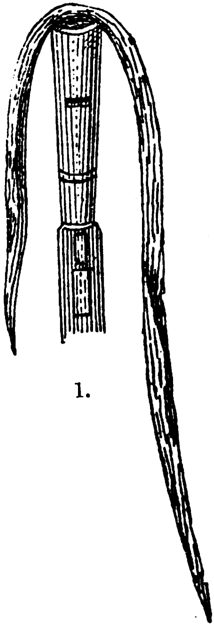
Treatment.—The patient should be placed in a half-sitting position so as to relax the muscles of the thigh, then a back-splint applied from the hip to the heel, fixed by a bandage round the thigh and above the ankle. A narrow-fold bandage laid above the upper fragment may be crossed behind the splint, and then tied off in front below the lower. The heel should be kept raised by resting it on the sound foot or a folded coat, and an ice-bag may be applied over the knee-joint.

(11) *Fracture of the leg.*—As in the forearm, one or both bones may be broken. The usual signs of fracture are present, but if only one bone is broken there will be no marked shortening of a limb. A break of the tibia (shin-bone) can generally be readily felt beneath the skin. The fibula often breaks about three inches above the ankle; fracture at this point, combined with dislocation of the foot outwards, is known as "Pott's fracture." Care must be taken not to mistake this accident for a dislocation, or even a sprain, of the ankle.

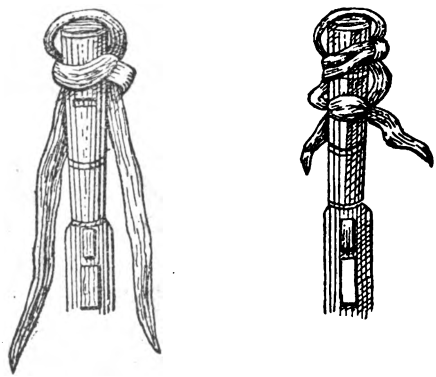
Treatment.—The limb should be brought into position and steadied by drawing on the foot, &c., as described in the treatment for fractured thigh. Splints should be applied on the outer and inner sides of the limb, reaching from the knee to beyond the foot, and both legs bandaged together.

(12) *Fractures of fingers or toes* require no special mention. They are treated on ordinary lines.

287. Compound fractures.—Any of the above fractures may be compound. They are much more serious injuries than simple fractures because of the wound in the soft parts leading down to the bone. The greatest precautions must always be taken against septic infection of the wound, as if this occurs, inflammation of the bone may arise, leading perhaps to general blood-poisoning and death.



1.



2. 3.

1. Narrow-fold laid on.
2. Half-hitch and half-knot above "D" for sling.
3. Butt-loop formed.

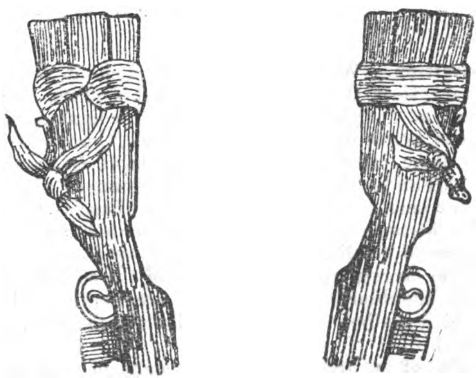
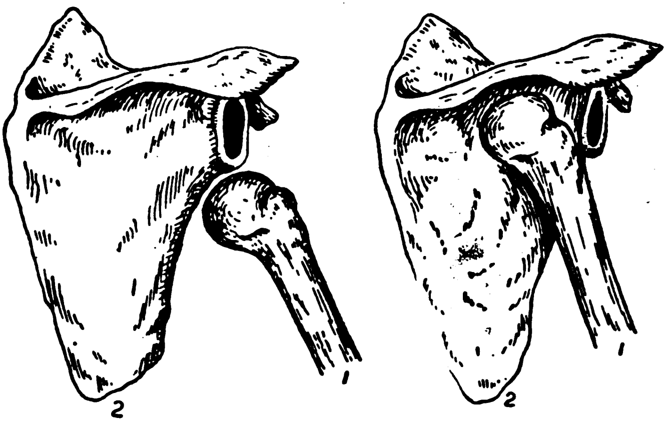


Fig. 110.—Formation of Butt-loop.

CHAPTER IX.

DISLOCATIONS AND SPRAINS.



1. Humerus. 2. Scapula.

FIGS. 111 AND 112.—DISLOCATION OF THE SHOULDER-JOINT.

Dislocation of the head of the humerus downwards into the arm-pit.

Dislocation of the head of the humerus backwards on to the scapula.

288. Definition.—When an injury to a joint occurs and the ligaments are torn, the bones may slip out of place. This is known as a dislocation. If, however, although the ligaments are torn or stretched, the bones do not slip out of place, the result is known as a sprain. Some joints are much more liable to dislocation than others: "ball-and-socket" joints on account of their extensive range of movement are more frequently dislocated than "hinge-joints"; for instance, dislocation of the shoulder-joint is a common injury compared to dislocation of the elbow-joint. Again, joints which depend largely upon the support of the surrounding muscles (such as the shoulder joint) are more frequently dislocated than joints in which the bones themselves give the main support (such as the hip-joint).

289. Signs of a dislocation.—The signs of a dislocation are: (1) alteration in the shape of joint when compared with the one on the opposite side; (2) the end of the displaced bone can often be felt through the skin; (3) alteration in the length of the limb; and (4) inability to move the joint.

A dislocation can be distinguished from a fracture by: (1) it always happening at a joint; (2) the limb, instead of being unnaturally movable, as is the case in a fracture, is unnaturally stiff; (3) if the end of the bone can be felt it is found to be smooth and rounded in dislocation, sharp and angular in fracture; and (4) by there being no grating.

It must be remembered, however, that a dislocation may be combined with a fracture; as, for instance, fracture of the humerus with a dislocation of the shoulder-joint.

A dislocation may also be compound; the meaning of this and need for special care has already been mentioned.

290. Signs of a sprain.—The signs of a sprain are: (1) severe pain, increased on movement; (2) inability to bear weight on the limb; (3) swelling round the joint; and (4) absence of special signs of fracture or dislocation.

291. Treatment.—The reduction of dislocation must be left to a surgeon. Any attempts at reduction by one unacquainted with the necessary manipulations may lead to severe injury to the patient.

Sprains require, as a rule, rest and the application of evaporating lotions.

CHAPTER X.

BURNS AND SCALDS.

292. Immediate treatment of burns.—The damage to the body occasioned by burns varies with the degree of heat applied to the part burnt: the more intense the degree of heat the more severe the burn. As regards immediate treatment, it should be remembered that severe burns, more particularly those situated on the head, neck, and trunk, and those which occupy a great extent of surface, are likely to be attended from the outset by serious constitutional disturbances described under the head of "Shock," and from which alone the patient may sink unless properly supported.

Burning clothing should be extinguished by laying the person on the ground and rolling him up in a rug, blanket, coat, curtain, or anything of this nature that is handy.

As the danger to life in severe burns comes from shock, the sufferer's general condition should receive attention first of all; this is important.

The charred surface is temporarily protected from septic infection owing to the germs in the skin having been destroyed by the heat. The treatment of shock should be carried out as described hereafter.

293. Dressing of burns.—The points to be aimed at in all cases are protection of the injured surfaces from the air, and relief of

pain. A burn or scald must be covered up as quickly as possible, and should on no account be exposed to the air longer than is absolutely necessary. This will be best accomplished by removing burnt clothing which is not adherent to the charred surface; never attempt to pull it off, but cut it. Any clothing, &c., adherent to the burnt surface should not be touched, but allowed to remain where it is. The injured part may then be immersed in, or be bathed with, warm water to which some bicarbonate of soda has been added. This will float off any charred clothing, &c., sticking to the part. The scorched or burnt surfaces may be dressed with lint covered with aseptic vaseline and boric acid powder. After the part has been dressed it should be enveloped in cotton-wool and put in the position most comfortable to the patient. The dressing had best be applied in a number of strips rather than in one large piece. This renders their subsequent removal easier to the sufferer; also, where a large surface has been burnt, by dressing in this manner and so exposing only a small portion at a time to the air, the tendency to shock is lessened. Boric ointment spread on strips of lint can be used in the same manner. Deeper burns destroying the skin are liable to become septic and require such antiseptic treatment as may be ordered by the surgeon. Burns should, after the first dressing, be dressed as seldom as possible.

During the subsequent treatment, the chief danger is sepsis and its results. Also, when the parts beneath the skin have been burnt the formation of disfiguring and deforming scars is frequent. To prevent and diminish these results the sufferer requires very careful nursing. Inflammatory affections, such as pneumonia, may follow after burns.

For burns of the face the dressings should be applied on a mask of lint or linen, in which holes are cut for the eyes, nose, and mouth.

294. Scalds and their treatment.—Scalds (which are caused by the application of hot fluids to the body) should be treated on the same lines as burns. When blisters form they may be pricked to permit the escape of their contents, but every endeavour should be made to avoid breaking the skin more than is necessary. If, after the first pricking (which should be done at the margin), the blister becomes again distended and is painful, a fresh outlet should be made and the fluid allowed to escape.

295. Convalescence.—The convalescence from extensive burns or scalds may be prolonged and tedious, and after the first ten days a generous diet with tonics will be necessary.

296. Suffocation from swallowing very hot water, or by inhaling steam.—This is rather a common accident among children, and is always serious. It may become rapidly fatal from swelling of the upper part of the larynx causing obstruction to respiration. Treatment in such cases must be prompt, and the sufferer constantly watched.

Treatment.—Fomentations must be applied to the front of the neck, from the chin to the top of the breast-bone (sternum). The patient kept sitting up and given ice to suck. It is best to have the sufferer at once seen by a surgeon, as surgical treatment may be required at any moment.

CHAPTER XI.

SHOCK, LOSS OF CONSCIOUSNESS AND FITS.

297. Shock is a condition produced by any severe injury or emotional disturbance. It is usual as a result of pain, or of injuries such as extensive burns or serious mutilation of the body. The sufferer becomes pale and cold, he lies in a semi-conscious and helpless state, the face pinched, the lips ashy, the temperature subnormal, the pulse feeble or almost absent. He often breaks out into a cold sweat, and may have fits of shivering, or be restless.

Treatment.—Restoration must be attempted by placing the patient in bed with the head low. Warmth must be restored to the body by warm bed-clothing, hot-water jars to the extremities, or the application of a mustard-poultice over the heart. Hot drinks should be administered and stimulants in small quantities, but care must be taken that the patient is conscious enough to swallow, or he may be choked by the fluid passing into the larynx.

298. Insensibility or loss of consciousness is due to various causes which damage or interfere with the action of the brain. It may be produced by pressure on the brain, as when bleeding takes place within the skull; by actual damage to the brain-substance, as results from a blow on the head, from a fracture of the skull; or, as is often the case, by interference with the circulation of the blood within the brain. It frequently happens as the result of the blood not being properly aerated in the lungs, either because the lungs do not act properly, or because the air supplied is impure, as when suffocation occurs in a room containing coal-gas, or other poisonous gases.

Treatment.—Medical assistance must at once be sent for. The patient laid on his back, and as a general rule, if the face is flushed the head kept high; if pale, the head should be kept low. All tight clothing round the neck, chest, or stomach must be loosened. If there is any inclination to vomit, the head must be placed on one side, so that the contents of the stomach may not get into the larynx and cause suffocation. All crowding round the person must be avoided, and free access of fresh air admitted. No food or stimulants must be given, unless by direction of a medical officer. The patient must not be left alone, but someone should stay with him till help comes.

299. Concussion is a variety of shock caused by injury to the brain, generally from a blow or fall on the head. The symptoms resemble those of shock, but are generally accompanied by a more

confused and bewildered state of the patient, or by complete unconsciousness.

The treatment is as for shock, but stimulants are not to be given without orders.

300. Fainting may be caused by over-exertion in hot weather or heated rooms, or by getting into the upright position when weak from disease, or it may result from hæmorrhage, or starvation, or from seeing some revolting sight, or it may follow fear or great grief. A fainting-fit is distinguished by the patient falling down in a helpless condition, generally insensible, without convulsions. The face and lips are pale and the surface of the body cold, often covered with a clammy perspiration.

Treatment.—The patient must be laid on his back with his head low, and the clothes about the neck and chest loosened. Cold water should be sprinkled on the face and neck. Smelling-salts applied to the nose, and, when the patient is able to swallow, stimulants administered in very small quantities. Fresh air is a necessity. If hæmorrhage be the cause it must be arrested immediately, and stimulants should not be given without orders. If it results from starvation, fluid nourishment, such as strong beef-tea, should be given, but only in moderate quantities at first. The patient must be left lying down for some time after he recovers.

301. Epileptic fits are due to constitutional, or local, causes. The patient falls down insensible, and has convulsions affecting part or the whole of the body, foams at the mouth, and often bites the tongue, making it bleed.

A fit may be divided into three stages ;—

1st stage.—This is often commenced by a peculiar cry. The patient then falls down quite unconscious. He becomes rigid all over, every muscle being contracted ; he holds his breath ; his face becomes pale and then livid. This stage lasts from 30 to 40 seconds.

2nd stage.—Unconsciousness continues ; but instead of rigidity, convulsions come on ; the eyes roll ; the tongue may be bitten ; and urine and fæces may be passed involuntarily. This stage lasts from one to four minutes and passes slowly into :—

3rd stage.—Consciousness is gradually regained. The muscular spasms cease ; the patient gradually comes to himself, but is very exhausted and confused mentally. He then frequently sleeps for some hours.

Treatment.—The patient must be laid on his back with his head slightly raised ; the clothes about the neck and chest loosened, and he must be prevented from biting his tongue by placing something (such as a spatula, or handle of a tooth-brush) between his teeth as a gag. Only sufficient restraint should be employed to prevent him injuring himself, and pressing on the chest must be avoided ; it will be sufficient if one man restrains the patient's legs—kneeling by his right side and placing the right arm across the knees to do so ; a second attendant lightly restrains the patient's right arm, and a third the left arm and also watches the head. Treatment will not cut short an epileptic fit.

302. Apoplectic fits occur mostly in elderly persons. The patient falls suddenly insensible. The face is red, the breathing loud and snorting, and the pupils frequently of unequal size.

Treatment.—The head and upper part of the chest must be raised and supported. The clothes about the neck loosened. Cold water applied to the head. Stimulants must not be given.

303. Compression of the brain is the result of severe injuries to the head, such as fracture to the skull; the symptoms resemble those of apoplexy, and the same precautions should be taken.

304. Sunstroke, or *heatstroke*, which is the result of excessive heat, occurs in hot climates or summer weather. The patient falls suddenly, generally insensible, sometimes in convulsions, the skin feeling burning hot to the hand.

Treatment.—The patient should be carried at once into the shade or the coolest available place. Plenty of fresh air provided. The head raised and the clothes removed from the neck and upper part of the body. The head, neck, chest and spine, or the whole body should be douched with cold water. Crowding round the patient must be avoided. Stimulants must not be given. Enemata of ice-cold water should be given.

305. Drunken fits are caused by the drinking of a large quantity of alcohol. They occur suddenly, but may not come on for some time after the liquor has been taken. The patient falls into a deep stupor; there is a vacant expression of the countenance, which is sometimes red. The lips are livid and pupils dilated, and the breath smells strong of liquor.

Treatment.—The patient should be placed on his side with head slightly raised and not allowed to lie on his back, or on his face. All constrictions removed from the neck and vomiting induced. The stomach-tube should be held in readiness in case the medical officer on his arrival should decide to use it.

CHAPTER XII.

SUFFOCATION, CHOKING, &c.

306. General symptoms.—These are as follows:—Violent attempts to breathe; staring eyeballs; distended prominent veins in the neck; purple countenance; convulsive movements of the body, &c. If the condition causing the suffocation or choking be not speedily removed, insensibility follows and death results. Such a condition is called *asphyxia.*

307. Choking.—This may be caused by pieces of meat, coins, false teeth or any other body lodging over the entrance to the windpipe and so causing obstruction to respiration. Treatment must be prompt. The mouth should be forcibly opened and the forefinger passed to the back of the throat endeavouring to hook up the obstructing body. In the case of children, they should be

held legs uppermost and the back thumped between the shoulder-blades. This should also be attempted in adults if the first mentioned remedy is ineffectual. In all cases a medical man should be sent for at once.

308. Suffocation by smoke or gas.—The person should be removed into the fresh air, and artificial respiration at once proceeded with to restore breathing. In mild cases respiration may be stimulated by freely douching the chest with cold water.

Poisonous gases are dangerous to life by replacing the oxygen in the blood.

309. Rescue from fire.—Before a person enters a building on fire, with a view to rescuing any individuals within, a wet handkerchief must be tied over the nose and mouth. Any superfluous clothing taken off and if possible a bucket of water should be thrown over him. It is imperative to work quickly; to avoid being overcome by the smoke by bending low beneath it—the air is clearest near the floor. When carrying persons out from burning buildings, the rescuer must try especially to protect from the flames the head and neck of those he carries.

310. Electric shock.—Contact with an electric cable may produce very severe shock, insensibility, and death. The sufferer is unable to extricate himself owing to the current depriving him of all power of movement.

It is imperative at once to get the sufferer away from the cable, and the person going to his assistance does so at great risk of being himself caught by the current. If the current can be switched off this should, of course, be done, but if this cannot be done endeavours to extricate the person must be made. The rescuer must insulate himself from the current. There is no time to search for india-rubber gloves or mats to stand on, as the sufferer must be got away immediately. A dry, wooden broom-handle may be utilized to push the person away from contact; or an empty, india-rubber tobacco pouch may be improvised as a glove. A coat held by the sleeves, or a belt or puttee may be thrown over the head or round the body of the victim to drag him away from the contact. All the common metals, iron, copper, brass, &c., are good conductors of electricity, and should be avoided; water, also, is a good conductor, and in dealing with electricity damp clothing should be avoided.

After rescuing the patient, the general treatment for insensibility must be carried out, and artificial respiration begun if breathing has ceased, any burns being left for treatment until the grave condition of shock has been overcome.

CHAPTER XIII.

EFFECTS OF COLD.

311. Frost-bite is the result of exposure to excessive cold. It affects the nose, ears, fingers or feet ; the part tingles and becomes blue ; and, in the more severe cases, white and free from pain. The treatment is to rub the affected part with snow or cold water, avoiding taking the patient into a warm room until the part has been thoroughly, but very gradually, thawed. All application of heat should be avoided, as it might produce gangrene.

312. Chilblains are local congestions of the skin, usually of the fingers and toes, caused by exposure to cold and wet. Damp and ill-fitting boots are a common cause. If the parts have become damp they should be thoroughly dried with a soft towel, then rubbed gently with some fine bran. Keep the parts warm and protected from the cold with woollen gloves or socks worn day and night.

The chilblain may be painted with tincture or liniment of iodine. If the surface is broken, zinc or boric ointment should be applied, and protected with cotton-wool. Exercise, good food, and warm clothing are the best preventives, and are necessary for the cure of this affection. Young people and those with a poor circulation are the chief sufferers.

CHAPTER XIV.

FOREIGN BODIES IN THE EYE AND EAR.

313. Foreign bodies in the eye.—Foreign bodies lodged in the eye, either on the eyeball or under the lids, cause severe discomfort, and if not quickly removed give rise to inflammation and great pain. Eyelashes sometimes get turned in and act as foreign bodies.

Treatment.—The patient should be prevented from rubbing the eye, and it should be carefully examined in a good light by pulling down the lower lid and gently pushing up the upper. If the foreign body is now visible, it may be removed by gently brushing it away with the folded corner of a handkerchief.

The patient may himself, by adopting the following simple methods, rid his eye of a foreign body :—(1) By blowing the nose violently several times in rapid succession, at the same time looking downwards and inwards. (2) By immersing the face in water, and at the same time opening the eye and moving it about to wash out the foreign body. (3) By taking hold of the edge of the upper eyelid, and drawing it downwards and forwards over the lower lid. On letting go the upper lid, the foreign body may be brushed off it

on to the lower lid, from which it may easily be removed. (4) By smelling any pungent substance, such as ammonia, which, by causing a free secretion of tears, may wash the body out.

Should, however, these methods fail, the following treatment should be adopted :—The patient should sit down facing the light, the attendant standing behind him and steadying the patient's head against his chest. The patient should be told to look down. A probe, or wooden match, or other similar object placed lengthwise on the upper eyelid about half an inch above the edge. The edge of the lid should now be grasped with the forefinger and thumb (left hand for the right eye and the right hand for left eye), drawn gently downwards and outwards, then turned quickly upwards, folded over the probe, which at the same time must be withdrawn with a downward and outward sweep. The eyelid having been everted, the foreign body may be seen and should be wiped off with a camel-hair brush, or the corner of a handkerchief. The lid should then be pulled forward to let it resume its normal position, the patient at the same time being told to look up.

A piece of grit, cinder or iron, sometimes becomes embedded in or sticks on the surface of the eyeball, causing great pain and intolerance of light. Such a foreign body may be recognized as a dark spot on the clear part of the eyeball (cornea). Its removal should be left to a medical officer. Pending his arrival, or until assistance can be obtained, the eye should be filled with olive oil, and a pad of cotton-wool or folded handkerchief bandaged gently over it.

314. Lime in the eye.—This is a very serious accident, and may cause rapid destruction of the eye. Remedies must be prompt.

Treatment.—The eye should at once be filled with olive or castor oil. The pieces of lime must be removed as quickly as possible and with the greatest gentleness; but no attempt is to be made to pick off any particles which have become adherent to the conjunctiva or eyeball; this should be left to the medical officer.

Or the eye may be bathed with a warm solution of vinegar and water (about two tablespoonfuls to a pint). By directing a stream of this on to a piece of the adherent lime it may be washed off. In no circumstances should force, ever so slight, be used in endeavouring to remove the pieces of lime.

315. Foreign bodies in the ear-passages.—In these cases the patient should at once be brought to hospital, or medical assistance sent for.

No attempt must be made, when the foreign body cannot be seen, to probe for it, or even syringe the ear, with a view to its removal. If an insect gets into the ear passages and becomes fixed, some olive oil should be poured in so as to float it out; but it is best in all cases to wait until a medical officer can examine the case. Should there be great pain, fomentations should be applied to the ear and side of the head.

CHAPTER XV.

DROWNING.

316. Restoration of the apparently drowned.—Medical assistance must be immediately sent for, and also for blankets, stimulants and dry clothing, but treatment should be instantly proceeded with on the spot, in the open air. The points to be aimed at are:—(1) The removal of all obstructions to the passage of air into the lungs; (2) the restoration of the breathing; (3) after breathing is restored, the promotion of warmth and circulation. The efforts to restore life must be persevered in for one or two hours, or until a doctor has pronounced life to be extinct. Efforts to promote warmth and circulation, beyond removing the wet clothes and drying the skin, must not be made until the first appearance of natural breathing; for if the circulation of blood be induced before breathing has recommenced, the restoration of life will be endangered.

317. Schäfer's method of resuscitation of the apparently drowned.—If breathing has ceased, the patient should be placed face downwards on the ground immediately on removal from the water, with the arms drawn forward and the face turned to the side.

Then, without stopping to remove or loosen clothing, respiration must be commenced as every incident of delay is serious.

To effect artificial respiration the attendant should place himself astride, or on one side of the patient's body, in a kneeling or squatting position, facing his head. Placing his hands flat on the small of the patient's back, with the thumbs parallel and nearly touching, and the fingers spread out over the lowest ribs, leaning forward with the arms straight and steadily allowing the weight of his body to fall on the wrists, and so produce a firm, downward pressure, which must not be violent, on the loins and lower part of the back (Fig. 113). This part of the operation should occupy the time necessary to count, slowly—*one, two, three.*

By this means the air (and water, if there be any) is driven out of the patient's lungs. Water and slime from the air passages may also run out.

Immediately thereafter, he should swing backward, rapidly releasing the pressure, when air will enter the lungs. The hands should not be lifted from the patient's body (Fig. 114). This part of the operation should occupy the time necessary to count, slowly—*one, two.*

This forward and backward movement should be repeated (pressure and relaxation of pressure) twelve or fifteen times a minute, without any marked pause between the movements. In other words, he should sway his body forwards and backwards upon his hands once in every four or five seconds.

Whilst the operator is carrying out artificial respiration, others may, if there be opportunity, busy themselves with applying hot flannels to the limbs and body, and hot bottles to the feet, or with

Schäfer's Method of Resuscitation

Fig. 113.—Expiration in Schäfer's Method.

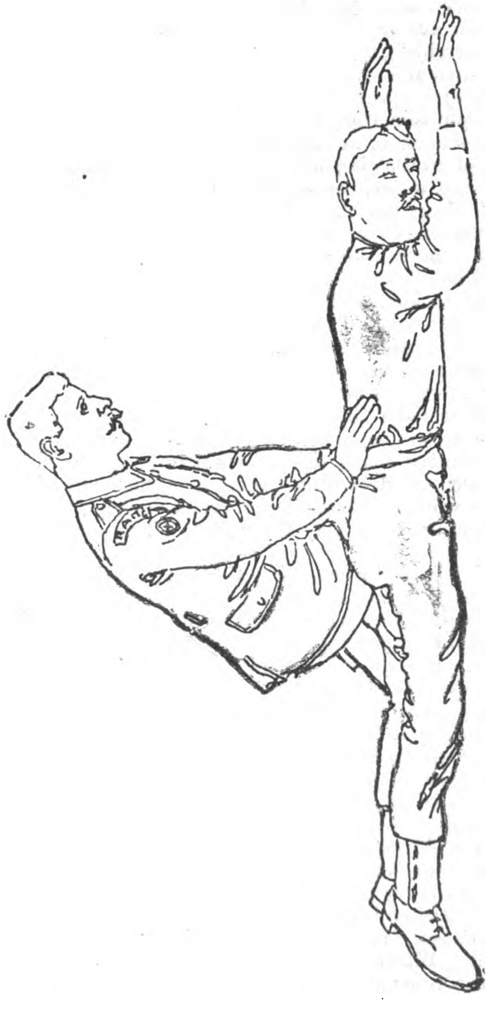


FIG. 114—Inspiration in Schäfer's Method.

promoting circulation by friction ; but no attempt should be made on the part of the operator to remove wet clothing, or give restoratives by the mouth, till natural breathing has re-commenced.

When this has taken place, the patient should be allowed to lie on the right side and friction applied over the surface of the body by using handkerchiefs, flannels, &c., rubbing legs, arms and body all towards the heart, and continued after the patient has been wrapped in blankets or dry clothing. As soon as possible after complete recovery of respiration, the patient should be removed to the nearest shelter. On restoration, a teaspoonful of warm water may be given, and, if power of swallowing has returned, small quantities of wine, warm brandy and water, beef-tea or coffee. The patient should be encouraged to sleep, but must be watched carefully for some time and free circulation of air allowed round the patient.

318. Further instructions. — Unnecessary crowding round the patient should be prevented, especially if in an apartment. Rough usage must be avoided and the patient not allowed to remain on his back unless the tongue is secured. In no circumstances should the patient be held up by the feet. On no account placed in a warm bath unless under medical orders.

Artificial respiration must also be resorted to in cases of suffocation either from the fumes of charcoal, or *choke-damp* in mining accidents, or from hanging ; also in cases of lightning-stroke, severe electric shock, chloroform poisoning, &c.

319. Rescuing a drowning person. — Although it is not necessarily the work of the medical corps, a description of how to rescue a drowning cadet may be useful. The means to adopt are :—

(a) *When the drowning cadet is quiet or unconscious.*—When the drowning cadet is quiet, he should be turned on his back ; the rescuer takes hold of him with one hand on each side of the head, and conveys him to shore, the rescuer swimming on his back. The drowning cadet's face should be held high above the water, and the rescuer should swim slowly with even movements.

If the cadet is unconscious, he should be supported by placing an arm under his chest and letting his neck rest on the shoulder. The rescuer works with his free hand as well as with his legs.

(b) *When the drowning cadet is violent.*—When the cadet has lost self-control from fright, and struggles or tries to seize the rescuer, the latter must catch him from behind, thrusting his hands under the cadet's arm-pits and placing them on the chest, at the same time lifting the cadet's arms towards the surface to make him float higher and give the rescuer a better grip. The cadet is conveyed ashore by the back-stroke.

320. Sometimes the rescuer has to free himself from the drowning cadet's clutch. When the drowning cadet grips the wrists from above, the rescuer should draw his arms together inwards and upwards over the cadet's arms, and then force them out sideways. If the drowning cadet grips the wrists from below, the rescuer must swing his arms quickly in a circle inside the

drowning cadet's, and then push them downwards and out sideways. In case of one hand or arm being gripped, the rescuer frees himself by bending his arm (assisting with his free hand) in the line of the cadet's thumb. In case the drowning cadet grips the neck or catches the arm or waist, the rescuer stoops over him quickly, and seizes him with one arm round the waist just above the hips, drawing him nearer to him ; and with the other arm—the hand being pressed against the cadet's nose and mouth, the butt of the hand under the chin—pushes his head and upper part of the trunk backwards. Should the drowning cadet not release his grip at once, the rescuer must bend one of his knees up against the lower part of the body, and pushing against this, force the cadet away from him.

CHAPTER XVI.

POISONING.

321. Definition.—A poison is any substance which on being absorbed into the organs of the body, or by chemical action on the tissues, injures health or destroys life.

322. Suspected cases.—A case of poisoning may be suspected by (1) the sudden appearance of the symptoms in a person otherwise healthy, (2) the symptoms coming on soon after food or drink has been taken. (If after a meal of which many have eaten, the symptoms will be complained of by several or all who have partaken of it.) The symptoms vary in character, and the treatment will depend upon the poison taken.

323. How poisons act.—Poisons injure health or destroy life in various ways, according to their nature ; *e.g.* (1) By actually burning the parts they touch, *i.e.*, the mouth, throat and stomach, and causing shock ; or by making the parts swell up so as to suffocate the patient. These poisons are called *corrosives ;* they may be acids or alkalies—oil of vitriol is an example of an acid, and caustic potash of an alkaline corrosive.

(2) Others by so irritating the parts they touch, such as the throat, stomach and bowels, as to cause inflammation, often severe in degree ; this inflammation gives rise to pain, vomiting and later on to diarrhœa which may kill the patient by exhausting him. These are called *irritant poisons*, examples of which are arsenic, phosphorus, decomposed foods, &c.

(3) By being absorbed into the blood and producing their poisonous action on the brain, nerves, heart, blood or other important organ, and so interfering with their function that death ensues. Examples of these are opium, chloroform, strychnine, prussic acid, snake-poison, arsenic. These are called *systemic* (*i.e.*, constitutional) *poisons*. Some poisons of this group are also called *narcotic poisons*, as they cause insensibility, *e.g.*, alcohol and opium. It is not unusual to find that certain irritant poisons produce

dangerous results on vital organs, when they become absorbed into the blood, in addition to their local irritant effects, *e.g.*, arsenic and carbolic acid.

324. Treatment.—In all cases of suspected poisoning, medical assistance should be sent for immediately, and the directions here given should be followed at once by the orderly, as no time must be lost.

Two main principles must be borne in mind in the treatment of cases of poisoning:—

First.—Try to remove the poison already taken, if possible or advisable.

Second.—Try to lessen the poisonous effects by giving the proper remedy, sometimes called the antidote.

Any poison remaining, all vomited matter, or anything likely to prove of importance in the inquiry which is sure to take place subsequently, should be carefully preserved for inspection.

When a poison, of which the nature is unknown, has been swallowed, the following combination may be administered:—

$$\left.\begin{array}{l}\text{Carbonate of magnesia}\\ \text{Powdered charcoal.}\\ \text{Hydrated peroxide of iron}\end{array}\right\}\text{equal parts.}$$

To be given freely in a sufficient quantity of water.

This preparation is harmless, and is an antidote to many of the most common and active poisons.

Hydrated peroxide of iron may be obtained by precipitating tinct. ferri perchlor. by liquor ammoniæ. Milk, or flour and water, may also be given.

(1) *Corrosive Poisons.*

Symptoms.	*Treatment.*
Great pain, immediately after taking the poison, in the mouth and throat, which look as if scalded; mouth and lips stained and blistered. Shock and perhaps difficulty in breathing. Breath may smell very sour, or of hartshorn.	*Emetics must not be given.* If the smell is sour, probably the poison is an acid, in which case magnesia-mixture, lime-water, or chalk and water, linseed or olive oil poured into the mouth help to stop further action by neutralizing the acidity. If the breath smells of hartshorn or does not smell acid, probably the poison is an alkali, in which case some weak vinegar and water or limejuice should be administered. Hot-water bottles should be applied to the feet and other means for restorating from shock resorted to. Remedies should be used as soon as possible. The tracheotomy instruments should be held in readiness.

Scrapings from whitewashed wall or ceilings may well be used in emergency as an antidote for acids. Weak liquor ammoniæ (liquid ammonia), or aqua calcis (lime-water), may be used to neutralize acids preferably to the carbonates, as the latter produce so much gas on combination that it may burst the stomach open.

Vinegar is the safest acid to administer.

The following are the most common corrosive poisons :—

Oil of vitriol (sulphuric acid), spirits of salts (hydrochloric acid), nitric acid, caustic soda, caustic potash, strong ammonia, oxalic acid (salts of sorrel) and carbolic acid.

(2) *Irritant Poisons.*

Symptoms.

Pain not at first very great; generally a sensation of burning, or a strong taste in the mouth and throat, coming quickly if the poison is liquid, and less quickly if it is solid when taken. The parts touched by the poison are not burned, and the pain is not so great as in the case of a corrosive poison, but it gradually increases and vomiting sets in, with pain in the stomach, diarrhœa with straining, and sometimes blood in the stools. Much can be learned by looking at the vomited matter. Shock and exhaustion set in generally.

Treatment.

Emetics should be given. Warm water should be given and vomiting encouraged until the water returns clear; then milk or white of egg, oil or melted butter to allay the irritation. The stomach-tube should be ready.

In phosphorus and cantharides poisoning, butter or oil should *not* be given.

The following are most common irritants :—

Copper, stale or badly tinned fish or meat, arsenic, antimony (tartar emetic), perchloride of mercury, zinc, iodine, cantharides and powdered glass.

(3) *Systemic Poisons.*

Symptoms.

No sign of burning, redness, or pain, but there may be giddiness, dimness of sight, drowsiness (gradually increasing), difficulty in breathing, irregular or weak pulse, delirium, cramps, convulsions. The pupils of the eyes either widely open or tightly closed, according to the particular system of the body affected—nervous, vascular, respiratory, &c.

Treatment.

Emetics should be given. The stomach must be emptied by means of emetics or the stomach-tube. Symptoms must be treated: that is, in case of drowsiness, the patient must be kept awake by being walked about, cold water being freely used, and hot coffee given. If the drowsiness becomes greater, or the breathing threatens to fail, artificial respiration should be resorted to sometimes for hours; if the pulse is weak, ammonia should be given (sal volatile); if there are cramps, gentle rubbing of the limbs; if delirium or convulsions are present, the patient should be carefully watched and kept as quiet as possible, and administered the special antidotes in the case of each poison. If the case is prolonged, nourishment should be given by the mouth or the rectum.

Emetics.—The following may be administered to produce vomiting :—

1. Mustard } One tablespoonful to a tumbler of water.
2. Salt }
3. Sulphate of zinc, grs. 30 in ʒ of water.
4. Ipecacuanha, grs. 20 to 30 of the powder ; *or* ʒss to ʒi of the wine.
5. Ammonium carbonate, grs. 20 to 30 in ʒi water.

It must be remembered that an emetic promptly given may save the patient's life, but one must not be given in a case of corrosive poisoning.

CHAPTER XVII.

IMPROVISATION.

325. In dealing with this subject it is not possible or desirable to lay down any hard and fast rules. Force of circumstances, as well as general surroundings and geographical position at the time, all enter largely into these matters. For instance, the occasions on which it may be required to improvise dressings, surgical appliances,

methods for the carriage or disposal of sick and injured, may be in peace or war, in winter or summer, in sunshine or rain, by road, rail, or sea, at home or abroad.

Much of the success attending the efforts to carry out any scheme for improvisation will depend largely on the ingenuity of those dealing with it. They must be guided not only by the immediate conditions and surroundings, but by the material at their disposal.

In this manual improvisation has been dealt with under various headings, it being an extremely necessary part of military medical training. For example, improvised tourniquets are dealt with in para. 262, improvised splints in paras. 285 and 286, improvised carriage of wounded in Chap. IX, Part I. Improvised methods of field sanitation are dealt with in Part I.

Further directions for improvisation not dealt with elsewhere are given in this chapter.

326. Dressings.—Linen, cotton, flannel, blankets, clothing, teased-out wool and tow, can be all used for improvised dressings. Any material used should be selected from as clean a source as possible. If time and circumstances allow, they should be thoroughly washed and boiled, then baked or sun-dried, and when cool used at once. When not required for immediate use they should be preserved in covered receptacles, which have themselves been previously sterilized as far as practicable, for instance, in tin biscuit-boxes, earthenware jars, &c., hermetically sealed with resin or strips of rubber-plaster, wax, or similar substance placed round the lid.

327. Sterilization.—Heat is the readiest and most desirable method of sterilization of all improvised dressings and instruments. It may be moist or dry. If moist heat be selected, any utensils which can be used for boiling purposes, such as large meat tins, biscuit-boxes, earthenware native cooking-pots, or kettles and pans, can all be used for boiling the instruments or dressings in. Dry heat can be obtained in the oven of a cooking-range, in which dressings must be thoroughly baked.

Moist heat is greatly preferable to dry, as it kills germs much more easily ; it should always be selected if possible. Instruments can be quickly sterilized by being held in a flame.

328. Antiseptic lotions.—The best substitute for these is water which has been thoroughly and recently boiled. It should be used fresh if possible, and not stored. But if storing is unavoidable, the vessels should themselves be sterilized by having water boiled in them, and they should be kept closely stoppered.

Weak solutions made of "Jeyes' fluid" or "Izal" have with success been used as substitutes for the better-known antiseptics.

PART IV.

Nursing.

CHAPTER I.

ATTENDANCE ON INFECTIOUS CASES.

329. Spreading of infection.—Infection is caused by the entry into the body from without of a living organism, a germ or microbe. These germs produce such infectious diseases as enteric fever, cholera, smallpox, plague, dysentery, malaria, &c. In nursing such cases, care must be taken to guard against the spread of infection by destroying the germs which leave the patient's body in the breath, discharges, and excretions, and are able to start the disease afresh in another individual.

330. Personal precautions.—It is the duty of the orderly to guard himself by all reasonable precautions against infection.

He should never go on duty fasting.

The finger-nails should be kept short, a nail-brush should always be used before taking a meal, and the hands washed and rinsed in some disinfectant immediately after touching the patient. As much fresh air as possible should be obtained, and no food should be eaten in the wards.

331. Disinfectant.—*A disinfectant* is something that "frees from infection." The most reliable disinfectant is heat in the form of boiling water, steam, or hot air of a temperature of 250° F. Articles that are disinfected by heat are said to be "sterilized," *i.e.*, they are rendered absolutely free from every kind of germ.

For articles that cannot be subjected to the action of heat, chemical disinfectants have to be used. These are very much less satisfactory than heat. Of chemical disinfectants the best are carbolic acid 1 in 20 (5 per cent.), or perchloride of mercury 1 in 1,000. If used in weaker solutions than these they cannot be relied upon to kill germs. Milk of lime and chloride of lime are also used for disinfecting stools.

332. Ventilation of wards.—Constant and free ventilation is the only method of purifying the air of a ward. Noxious emanations are given off by the patient's body, which are hurtful not only to himself but to his attendants; the risk of the latter catching disease is much diminished by free ventilation.

The window should be kept constantly open at the top, care being taken to guard the patient from draughts. When not too cold, the windows should be opened top and bottom two or three times a day, and the room thoroughly flushed with fresh air, the patient being carefully covered up. A fire is an aid to ventilation (*see* para. 418).

333. Disinfection of linen.—A supply of bedding and clothing distinctively marked with an "I" should be set apart for the use of patients suffering from infectious diseases. Both bed and body linen should after use be at once placed in a disinfecting solution, unless specially directed to be dealt with in any particular way.

Especial care is necessary in the treatment of soiled linen from enteric fever patients. All excretal matter should be rinsed out before placing the articles to steep in the cresol solution. Hands must be carefully scrubbed after touching soiled linen.

334. Disinfection of stools and urine.—In enteric fever the infectious germs are contained in the stools and urine of the patient.

Unless otherwise ordered, a small quantity of cresol solution or other disinfectant should be put in the bed-pan and care should be taken that no moisture from the disinfectant remains on the outside of the bed-pan. After use it should be covered up with a china cover and removed at once from the ward, enough cresol being added completely to cover the stool, at least 8 fluid ounces being used, the whole being well mixed by stirring with a piece of stick.

Where water-closets or slop-sinks do not exist, the best method of disposing of enteric stools is to boil or burn them. Where a water-closet or slop-sink is available for their disposal, before emptying the stools into these they should be mixed with an equal quantity of cresol solution and allowed to stand for one hour to allow the disinfectant to act.

While the stool is standing, the bed-pan with the china cover should be covered with a cloth soaked in cresol solution. This should also be done when a stool is being kept for inspection.

The urine should also be well mixed with an equal quantity (at least 4 ounces) of the cresol solution and allowed to stand for an hour before being emptied, if no special method is arranged for its disposal.

All utensils (*e.g.*, feeding-cups, bed-pans, urinals, &c.) intended to be used by enteric patients must be marked with an "E."

335. Disinfection of sputum.—Cresol solution should be placed in the spit-cup before use.

Rags or special handkerchiefs which can be burnt should be used to wipe away all discharges from the mouth and nose.

336. Disinfection of patient's body.—The patient should be carefully sponged from head to foot daily, care being taken that he is not unduly exposed.

In scarlet fever the flakes of skin which become detached from the body during the process of desquamation may convey the infection. Some medical officers therefore have their scarlet fever patients, during the peeling stage, anointed daily from head to foot with some disinfectant dissolved in olive oil. This prevents the escape of dust and particles of skin from the patient. In addition, warm baths are frequently given during convalescence.

337. Dusting of patient's room.—The dusting of a ward should be done with a duster damped with some disinfecting solution, to prevent the dust, in which infectious germs may be present, being scattered about; after use the duster should be at once placed in the tub containing the disinfecting solution.

All crockery used by infectious cases should be specially marked and kept for this use only.

CHAPTER II.

MEDICINES AND THEIR ADMINISTRATION.

338. Methods of giving drugs.—Drugs may be introduced into the system in several ways. They may be swallowed, inhaled, injected under the skin, rubbed into the skin, injected into the rectum, or administered by means of medicated baths.

339. By the mouth.—The great majority of medicines are given by the mouth. Drugs given in this way may be administered in the form of liquids, pills, powders, or in capsules.

*Liquids.**—Before a dose of mixture is given the label must always be read, the bottle shaken, and the exact dose poured into a graduated measure-glass. The quantity must never be guessed, and spoons are not reliable measures.

When a certain number of drops are to be given a minim-measure should if possible always be used, since drops vary very much in size with the character of the fluid and the shape of the bottle. When one or two minims of a medicine are ordered, measure ten minims and then add enough water (unless any special vehicle is ordered) to bring it up to ten drachms. Each drachm of the mixture will contain one minim of the medicine.

While pouring out the medicine the bottle should be held with the label uppermost, that this may not be soiled if any drops should run down the side, and so obliterate the directions.

Pills.—These contain drugs in a solid form. The patient should take a small mouthful of water, then put the pill in the mouth and drink a little more water.

Powders.—When small, these should be shaken on to the back of the tongue and then washed down with a drink of some fluid; when too large to do this, they must be mixed with water.

Capsules.—These are small pear-shaped receptacles made of gelatine, which are sealed up after having a dose of the drug placed in them.

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* Medicines intended for external use are so labelled, and if containing a poison are dispensed in fluted bottles and labelled "Poison."

Tablets.—In addition, certain drugs are often compressed into tablets, and these may be given in the same way as pills.

340. By the lungs.—Drugs given in this way are inhaled. Medicines which are inhaled, *i.e.*, drawn in with the air at each-inspiration into the lungs, are usually intended to act upon the lungs, and are therefore almost entirely reserved for cases in which these organs are affected. Inhalations are also used for sore throats and when the larynx is inflamed. Lastly, certain drugs, such as chloroform, ether, &c., are inhaled for the purpose of producing general anæsthesia.

Oxygen is often employed in cases of pneumonia, and in other diseases of the lungs. The gas is contained in a metal cylinder which is brought to the bedside. The flow is regulated by means of a stop-cock, and the gas is conducted from the cylinder through rubber tubing. If the patient is strong enough, he inhales the gas through a glass funnel (which is attached to the rubber tubing) held before the mouth and nostrils. The effect is carefully watched, the flow of gas being restricted, or the funnel removed further away, if any distress becomes apparent.

341. Hypodermic injections.—By this method the drugs to be adminstered are injected under the skin. "Under the skin" is the meaning of both "hypodermic" and "subcutaneous." Absorption into the circulation is very much more rapid by this way than any other, the drug taking effect within from one to five minutes. Being such a potent method, it is as a rule used only in cases of emergency, *e.g.*, for the relief of pain, to induce vomiting, or to stimulate the heart.

Intra-muscular injection is when the injected drug is pushed much deeper, *i.e.*, into the muscles, as in the intra-muscular administration of mercury.

342. Inunction means the rubbing of an ointment into the skin. The portion of the skin to be treated should first be washed with soap and water, and then dried. This stimulates the circulation in the skin and enables it more quickly to absorb the medicament. This method of introducing drugs into the system is practically reserved for the administration of mercury. The chief point to be remembered is that the ointment must be rubbed into the skin and not left on it, the part being thoroughly massaged with the palm and finger-tips. It should take from twenty minutes to half an hour to rub in the usual dose of mercurial ointment. The orderly should carefully wash his hands immediately afterwards. The same spot should not be selected each day, as the skin may become inflamed.

343. Rectal medication.—Drugs may be introduced into the rectum in either a liquid or a solid form. They are given in this way when the patient is unconscious or vomiting, or for the relief of diarrhœa or rectal pain, or for stimulating a patient who has collapsed after operation. Liquid preparations should be slowly run in through a glass funnel and rubber tube.

Suppositories are solid preparations of a conical shape and of varying sizes, according to their contents. The suppository is oiled and slowly passed well into the rectum.

344. Accuracy in giving medicines.—Full directions are, as a rule, given as to the time of administration of each dose of medicine. It should always be punctual to the minute. Three-times-a-day medicines are usually given at 10 a.m., 2 p.m., and 6 p.m. ; twice-a-day, at 10 a.m. and 6 p.m.

A medicine that is ordered to be taken "before meals" should be given a quarter of an hour before food, and one to be taken "after meals," immediately after the meal is finished.

A double dose of medicine should never be given at one hour because the previous dose has been forgotten.

After each dose of medicine the measure-glass must be washed.

All medicines should be carefully labelled. All poisons should be kept in a separate, locked cupboard. The liniments and lotions should stand on a shelf by themselves.

60 minims	(m. lx)	= 1 fluid drachm.	(ʒ i)
8 drachms		= 1 ounce.	(℥ i)
20 ounces		= 1 pint.	(O i)
8 pints		= 1 gallon.	(C i)

CHAPTER III.

ENEMATA.

345. An enemata is a liquid preparation which is injected into the rectum. It is chiefly given to produce an action of the bowels, to relieve pain, to stimulate, or to feed the patient. Its composition and size vary with the purpose for which it is used. Nutrient enemata and those prescribed to allay pain are usually small in quantity, those intended to clear out the bowels are large.

346. Method of administration.—The patient is usually placed on the left side or on the back. It is the more convenient to have the patient lying on his left side, since the large intestine runs backward from the anal aperture in the direction of the left hip ; but it sometimes happens that it is impossible to put him in that position—as, for instance, after an abdominal operation, or injury to the pelvis. In such a case the enema must be given with the patient lying on his back. This is more difficult, and it is wise to practise giving it in this position so that when necessary it may be done easily and not cause the patient discomfort.

When the enema is given with the patient lying on his side, the hips must be brought to the edge of the bed and flexed, also the knees. A warmed mackintosh covered with a towel is then placed

under the patient, and the bed-clothes, with the exception of one blanket, turned back. The vessel containing the fluid to be injected should be placed in a convenient position, and the catheter or nozzle of the syringe oiled. The index finger of the left hand should be passed between the buttocks, and laid lightly on the anus, and the tube passed below the finger into the rectum, directing it upwards and backwards. No force must be used, the tube must be carefully passed over the small tongue of integument which is found at the anterior angle of the anus.* If the Higginson's syringe is used the fluid must be pumped in with the right hand. Five minutes should be occupied in injecting one pint. There should be no attempt at hurrying, otherwise the enema may be instantly returned.

If the patient may not be turned on his side, he should, lying on his back, be brought as near to the edge of the bed as possible, the right knee flexed, and the anus found as before with the index finger of the left hand. The tube is then gently passed with the right hand, being directed backwards and slightly downwards. When the injection has been given the tube should be gently and slowly removed from the rectum, and firm pressure at once applied upon the anus with a folded towel to assist the patient in retaining the enema. The buttocks being pressed together also assists in this way.

347. Purgative enemata.—Purgative enemata are given either with the object of assisting an easy action of the bowels, *e.g.*, before and after operations, or for the relief of constipation.

Soap-and-water enema.—This is made by dissolving one ounce of soft soap in a pint of warm water. Ordinary yellow soap can be used. One pint is the usual quantity. This is generally administered with a Higginson's syringe, often with a No. 12 catheter attached to the nozzle. The temperature of the fluid should be about 100° F. The air should be expelled from the tube before it is inserted. The enema should be retained for from eight to ten minutes. When giving any sort of purgative enema, a warmed bed-pan should be ready at hand for use, to prevent accidents.

CHAPTER IV.

EXTERNAL APPLICATIONS, COUNTER-IRRITANTS, POULTICES, &c.

348. A gargle is used as a wash for the mouth and throat. A tablespoonful is to be taken into the mouth, the head then thrown slightly back and the fluid set in motion by breathing through it, at the same time taking care not to swallow any. This should be repeated two or three times on each occasion.

* Almost immediately the muscle will relax and the tube slip in.

349. Eye-lotions are used for washing away discharges from the eye. They are applied by means of a vessel called an "eye-bath," by a special irrigator, or by allowing a steady stream from a pledget of cotton-wool, held about two inches above the eye, to run over as much of the inner surfaces of the lids as possible. This is most effectually done by everting the eyelids (see para. 313). This done, retaining the upper lid in position by means of the thumb, the lower lid is now easily everted by placing the forefinger on the skin below the eye and drawing it downwards, the patient at the same time looking upwards.

350. Eye-drops are applied in different ways according to the purpose for which they are used. When they are intended to act upon the conjunctiva, the lids must be everted in the usual way and the drops allowed to fall vertically upon the inner surfaces. When drops are used with the object of dilating or contracting the pupil, the lower lid is drawn downwards and one or two drops allowed to fall on its inner surface. Before using the drop-bottle, two or three drops should be allowed to escape from the nozzle so that any foreign matter in it may be washed away.

351. Counter-irritants are local applications used for the relief of pain or the checking of inflammation, some producing mere reddening of the skin, and others actual inflammation.

Mustard-plaster.—Two parts of mustard to one of flour are made into a paste with tepid water. This is spread evenly on a piece of linen cut to a suitable shape and size, and is covered with a single layer of washed muslin ; it is then ready for application.

Mustard-leaves.—These are more convenient to apply than the plaster. They should be moistened in warm water before application, the skin having been previously cleaned.

Application of iodine.—The skin should first be washed, and then the iodine painted on with a camel-hair brush. After the first coat has dried a second should be applied.

When a strong solution of iodine is ordered, the directions as to its application must be minutely observed, as it is very much stronger than the tincture and causes considerable irritation to sensitive skins.

Liniments are very mild counter-irritants, which are rubbed in by the hand after the part has been washed.

Blisters.—These may be applied in the form of a plaster, or painted on the part. When the plaster is used, the part should be well washed with soap and water, and sponged with ether to remove grease from the skin. The plaster is cut to the shape and size required, moistened with warm water, placed in position and secured loosely with a bandage, so as to exert no pressure on the blister when it rises.

When blistering-fluid is used the part to be painted, having been previously washed, should be outlined with vaseline or oil to keep the fluid within the required space. Two or three coats are then painted on and the part covered with wool and a loose bandage.

The plaster should be left on from ten to twelve hours. If the blister has not risen then, a fomentation should be applied. The plaster is then carefully removed, and the blister which has been produced is snipped at its most dependent point with a pair of sharp sterilized scissors, and the fluid gently pressed into absorbent wool. Sometimes the fluid is allowed to be re-absorbed, the blister being left unopened and merely protected with wool and a bandage.

The actual cautery.—As a counter-irritant this may be used—(*a*) For the relief of pain, in which case the heated point is not brought into contact with the skin, but is moved to and fro just above it so as to produce a reddening of the surface. (*b*) For the treatment of chronic joint inflammation. Here the point of the instrument, which is kept at a dull red, is lightly drawn across the part to be treated so as to produce a superficial burn, which is dressed in the ordinary way.

352. Leeches are used for the relief of pain and for checking inflammation. Each leech draws from one to three drachms of blood. The smaller pointed end is the head of the animal.

Before applying a leech, the skin should be well washed and thoroughly dried, and when possible briskly rubbed to bring the blood to the surface. It is important to handle the leech as little as possible. A leech will continue sucking for about three-quarters of an hour. It should never be forcibly removed, or its teeth may be left in the skin, which would produce a troublesome wound. A pinch of salt sprinkled on the head will make a leech relax its hold. If the bleeding is to be encouraged, a fomentation should be applied to the bites, otherwise a pad of gauze should be strapped over them. The patient should be carefully watched until the bleeding has ceased, as sometimes this is very troublesome.

353. Ointments may be applied either spread with a spatula on the smooth side of a piece of lint, or they may be rubbed in with the hand, that is to say, by " inunction."

354. Lotions.—Evaporating lotions must be applied on a single thickness of lint, which should be left uncovered. Other lotions are applied by soaking a double thickness of lint in them, squeezing out the excess of moisture but without wringing them dry, and covering with jackonet or oiled silk to prevent evaporation.

355. Poultices are of various kinds, the most common being linseed and mustard.

Linseed-poultice.—Crushed linseed is most commonly used for a poultice.

To make a poultice, a board, a bowl, a kettle, a jug of boiling water, and a large spatula or flat knife are required ; also tow or linen on which to spread the poultice. If tow is used it must be pulled out flat and even to the required size.

After the knife and bowl have been heated, a sufficient quantity of boiling water from the kettle is poured into the bowl. The linseed is then added, being quickly sprinkled in with one hand,

while the mixture is stirred with the spatula. When sufficient meal has been added the mixture will come away clean from the edge of the bowl and should be turned out on the linen or tow, and spread evenly and quickly with the spatula, the latter being dipped in the jug of boiling water between each stroke. The layer of linseed-meal should be a quarter of an inch thick, and it should be spread to within one inch of the edge of the linen or tow, when the former should be folded and the latter rolled in all round. Care should be taken not to apply the poultice too hot; this can be prevented by first testing it on the back of the hand. When placed in position the poultice should be covered with a thick layer of cotton wool and secured by a bandage.

Mustard-poultice.—This is mustard mixed with linseed, the mustard being mixed separately with lukewarm water and then added to the linseed-poultice. The proportion of mustard to linseed varies with the object of the poultice, being either of equal parts or one of mustard to two of linseed.

356. Fomentations or Stupes.—The best material for a stupe is thick soft flannel. Spongio-piline is sometimes used, also lint and absorbent wool. Boracic wool is used for surgical cases. If used for the relief of pain, a fomentation should be changed every half-hour at least.

The material for the fomentation should be placed inside a towel or wringer and laid across a bowl which has been heated, the ends of the towel or wringer projecting over the sides. Boiling water is then poured over it, after which it is wrung out dry in the towel, taken out, and applied as hot as the patient can bear it. It is then covered with jackonet and wool, and bandaged firmly in position.

Turpentine stupe.—One or two drachms of turpentine are sprinkled carefully on the flannel before being wrung out of the boiling water.

Opium and belladonna are sometimes applied on stupes, half a teaspoonful of the tincture being sprinkled on the flannel after it has been wrung out.

357. Hot bottles may be of tin, earthenware, or india-rubber. For the feet, either tin or earthenware are suitable. For any other part of the body an india-rubber bag is more comfortable and efficacious. All hot bottles should be protected with thick flannel covers. Care must be taken that the bottles do not leak, and that there are no holes in the covers. It must be remembered that the following patients are peculiarly liable to be burnt; those who are unconscious from any cause, the paralysed, those who are suffering from great pain, the dropsical, the very young, and the old.

358. Ice bags are made of various shapes and sizes to suit the part to which they are to be applied. The cup-shaped ice-bag is the one generally used. This should be half-filled with small pieces of ice, with which may be mixed a little common salt to intensify the cold; sawdust or linseed-meal may be added to soak up the water and so make the ice last longer.

359. Ice-poultice.—Crushed ice between thin layers of linseed-meal is spread to the depth of half an inch between two layers of tissue. The tissue is then sealed up all round with chloroform or turpentine.

CHAPTER V.

BATHS, PACKS, &c.

360. Temperature of baths.—In addition to the ordinary cleansing bath, baths are ordered for a variety of purposes. The temperature of these varies somewhat, but, as a general rule, by a *warm bath* is meant one about the temperature of the body, say 98° F.; a *tepid bath* is about six degrees less, say 92°; a *hot bath* is about six degrees more than 98°, say 104°. The bath-thermometer should be used on all occasions.

Before giving any kind of bath, instructions should be obtained as to the temperature of the bath, and the length of time the patient is to be kept in it.

361. Cold bath.—A cold bath is given at about a temperature of 65° F. It is given in cases of hyperpyrexia. In many cases it is not considered advisable to lower the patient directly into the cold water, the temperature to begin with being as high as 85° F., and being cooled down by the addition of iced water.

362. Hot bath.—A hot bath is given to relieve pain in renal colic, to soothe excitement in cholera and delirium, to relieve retention of urine, and to promote perspiration in uræmia.

These baths are usually given at the bedside, the patient being lifted into them from the bed.

363. Hot-air bath.—To give this a special apparatus is necessary. Allen's apparatus without the boiler is generally used.

Blankets are placed over and under the patient, and his shirts removed. A mackintosh must be placed under the lower, and two wicker-work body-cradles over the upper blankets. These are covered with two blankets, over which is placed a mackintosh, and over that again another blanket. The blankets should be well tucked in under the mattress. From the foot of the bed withdraw the blankets covering the patient, insert the spout of the kettle just within the lower cradle and light the lamp, which has several wicks. The spout should be guarded by asbestos, otherwise the blankets which are pinned round it will be scorched. A cloth wrung out of iced water should be laid over the patient's forehead and kept cold. He should also be given cold water to sip.

In the absence of any special orders, the duration of a hot-air bath is 20 minutes. At the end of that time the light should be put out, the hot-air pipe withdrawn, and a warm, dry blanket slipped in under the cradles. The temperature may be from 108° F. to 150° F.

The latter heat can only be borne when the baths have been in use for some time. The mackintosh and cradles will then be removed and the patient left lying between blankets for an hour until he has done sweating; he should then be sponged with warm water, and a warm flannel shirt put on.

If the patient shows signs of exhaustion or faintness during the bath, the lamp must be put out at once and the cradles removed.

364. Vapour-bath.—This is given in the same way, except that the boiler is used in the apparatus, and the steam from the boiling water is introduced into the bed instead of hot, dry air. The water should be boiling when the apparatus is inserted, and the boiler must not be more than half-full. The temperature may be from 105° F. to 110° F.

365. Continuous bath.—This is ordered sometimes for cases of skin-disease, extensive burns, and severe local surgical injuries or disease. The bath may last for some days and should be kept at an even temperature of 100° F. A thermometer should be kept constantly in the bath.

The bath is easily kept hot by removing some of the cooled water from time to time and adding hot water about 200° F., care being taken not to burn the patient in so doing.

366. Arm- and leg-baths are much used for septic cases. They are given in a special, trough-shaped bath. The bath is half-filled with water, to which the prescribed lotion is added. The temperature should be 100° F.

367. Medicated baths:—

Sulphur-bath.—Six ounces of potassa sulphurata are required for thirty gallons of water. The sulphur should be first dissolved in boiling water and then added to the bath.

Iodine bath.—To every pint of water one drachm of tincture of iodine is added. This is usually given as a local bath.

Bran-baths.—Put four pounds of bran in a muslin bag and pour over it at least one gallon of boiling water. Fill up the bath, squeezing the bag of bran. Temperature 100° F.

Alkaline-baths are prepared by adding six ounces of carbonate of soda, or potash, to a hot bath. This bath is given for rheumatism.

Brine-baths are prepared by adding about six pounds of common salt to an ordinary hot bath.

368. Hot pack.—Prepare the bed by rolling under the patient a long mackintosh with a blanket over it. Cover the patient with a blanket and remove his shirt. Take a large sheet, fold it across into four. Wring it out of water as hot as possible, using a sheet or large bath-towel as a wringer. Lay the patient on his back in the bed, lay the hot sheet over him, moulding it well into him, well into the neck and down the sides. Turn up the sides of the blanket he is lying on. Cover with a mackintosh and plenty of blankets.

Hot drinks promote perspiration. The patient should remain in the pack for twenty minutes. Take away the wet sheet, blanket, and mackintosh, and cover up the patient with a hot, dry blanket and leave him for an hour.

369. Cold pack.—Prepare the bed as for a hot pack, wrap the patient in a sheet wrung out of cold water. If the feet become very cold a hot bottle may be put to them. The sheet must be kept cold by being rubbed down with pieces of ice, or by being constantly sprinkled with iced water.

The temperature must be taken every five minutes, and the pulse watched. The duration of the pack depends upon its effect on the temperature.

370. Sponging is employed to reduce the temperature during fever by the evaporation of water applied to the surface of the body. Cold or tepid water is usually used. A blanket should be rolled under the patient and the shirt removed, bath towels being tucked in on each side to catch any water that may run down. The bed-clothes, with the exception of one blanket, are removed. The whole body should not be exposed at one time, only the part to be sponged being uncovered. Sponge the part rapidly, particularly over the great vessels at the root of the neck and in the groin. After sponging, the patient should only be lightly dabbed with a towel. The water should be maintained at the temperature ordered, by adding either iced water, or ice, as required.

CHAPTER VI.

THE NURSING OF HELPLESS PATIENTS.

371. Washing of patients.—When a patient is too ill to go to the bath, he must be washed all over in bed between blankets, a mackintosh being placed under the bottom blanket. This blanket-bath should be given on admission to all patients who are unable to take an ordinary bath, and, at least once a week, to all patients confined to bed. When giving a bath, any swellings, scars, scratches, or sores should be noted and reported.

Every day each patient confined to bed should be washed as far as the waist, back and front, the shirt being removed. This thorough washing should be done in the morning, and should include the skin over the sacrum, buttocks, and hips. The hands should again be washed in the middle of the day, and the face and hands at night, also the skin over the sacrum, buttocks and hips. The hair must be combed and brushed, and the patient's brush and comb should be washed at least once a week. The teeth must be washed daily.

372. Cleansing of mouth and teeth.—In acute illness, sordes and mucus collect on the teeth and give them a dirty appearance. When this accumulation of sordes and mucus is rapid, and when the lips and tongue are stiff and dry, attention may be needed every hour, but in ordinary cases twice a day will suffice. The mouth should

be kept as moist as possible. The best sponges for washing out the mouth are made of squares of white gauze or lint, which should be burnt directly after use. One of these squares should be wrapped round the index finger, soaked with the wash and inserted into the mouth. The teeth, gums, roof and sides of the mouth should all be gone over. A solution of boracic, or lemon-juice and glycerine may be used. Dressing forceps or small sticks of wood may be used instead of the finger, but the latter is most efficacious. The hands must, of course, be well scrubbed directly after in antiseptic solution.

373. Bed-sores.—To guard against these is one of the most important points to remember with helpless patients. Bed-sores result from continuous pressure on a certain spot or spots, also from friction, moisture, creases in the under-sheet or shirt, and from crumbs in the bed. Bed-sores due to pressure occur most frequently on the hips and lower part of the back, the shoulder, and the heels. Those from friction are apt to come on the ankles, the inner surface of the knees, or on the elbows and back of the head from frequent movements. With patients suffering from paralysis or spinal injuries the utmost care will not always avail, but generally with good nursing, bed-sores can be avoided.

Preventive measures consist in absolute cleanliness, and the removal of pressure. The back and shoulders should be washed with soap and water and carefully dried night and morning. After washing, the skin should be treated with spirit in some form—methylated spirit, brandy, or eau-de-Cologne—which should be well, but gently, rubbed in, the parts being then dusted with oxide of zinc and starch powder. In cases where the sphincter muscles are relaxed the skin should be treated with ointment to protect it from the irritating effects of the discharges, the patient being frequently washed.

Water- and air-beds are of the greatest possible value. Rubber ring-cushions are also very useful. The knees, ankles, and elbows may be protected by a thick layer of cotton-wool firmly secured by a bandage. When possible, a patient should never be allowed to lie more than two hours in one position. He should be turned first on one side and then on the other, and kept there by an arrangement of pillows.

The first indication of an on-coming bed-sore should be at once reported.

374. The moving of helpless patients.—It requires two people, one on each side, comfortably to move a really helpless patient. Each passes one hand under the patient's back at the lower part of the shoulder-blades, the hands being then locked together. The other hands are passed beneath the patient's thighs close up to the hips, and also locked together. The patient is then steadily raised and placed in the sitting position.

If the patient is not too weak, and is able to help himself with the pulley, one person can raise him in bed by putting the right hand and arm well behind his back, and the left below the hips, gradually

moving him up the bed, the patient at the same time assisting himself with the pulley.

Should the patient have an injury to the legs, a third person will be required to support the lower extremities.

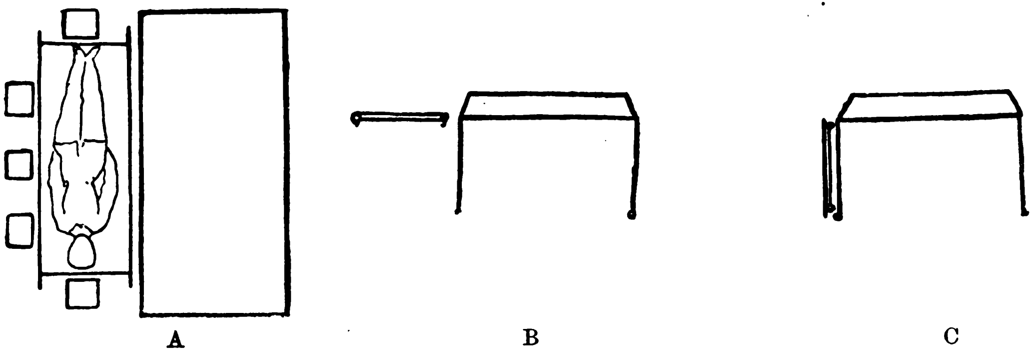
To move a patient from one bed to another, the two beds must be placed side-by-side so that the mattresses are in contact. The patient is then drawn slowly across by the sheet on which he is lying, this being afterwards slipped away from under him. If there are enough assistants, he can be lifted, one taking each corner of the sheet.

To prevent a patient who is very weak from slipping down into the bed after being propped up, a bolster is rolled in a draw-sheet and placed beneath the upper part of the patient's thighs, the draw-sheet being then tucked firmly in at the side of the bed.

375. Removal of a helpless patient from a stretcher on to a bed or operating table.—To remove a patient from a stretcher to a bed or operating table, the bearers carrying the stretcher bring it alongside and raise it to the level of the bed (or table) as in B of Fig. 115. Two, or preferably three, other bearers standing on the far side of the stretcher, raise the patient as described in Stretcher Exercises, Part II (Chap. I) for lifting wounded. The bearers carrying the stretcher keep that handle which is nearest to the bed (or table) steady, and allow the opposite handle to fall like the flap of a folding table, so that the stretcher assumes the position in C of Fig. 115. The bearers supporting the patient then move forward and lower him on to the bed (or table); the stretcher is then removed.

To remove a patient from a bed or operating table the process is reversed.

376. Changing the sheets.—Unless the patient is very ill, one person can do this easily. Only the upper sheet or a single blanket is to be left over the patient. The lower sheet and draw-sheet to be removed are loosened at the top, bottom, and each side of the bed. On one side they are then folded along their whole length as flatly as possible until they are close up to the patient. The fresh sheets should then be folded lengthwise alternately backward and forward for half their width, and placed on the side of the bed from which the soiled ones have been removed, the loose halves being tucked in at the side. The orderly then moves to the opposite side of the bed, and turns the patient on his side, facing him. The patient can be supported in this position with one hand, while the sheets to be removed are tucked as closely and smoothly as possible up to his back, their place being taken by fresh ones which are made to follow them closely. Using both hands, the orderly now gently turns the patient towards the side of the bed away from him. The soiled sheets and the folds of the clean ones are then drawn through, the former being taken away and the latter smoothed down and tucked in their place, care being taken not to leave the smallest wrinkle. The patient can often assist in this changing by a pulley suspended above the bed, by means of which he can raise himself



A Patient on stretcher alongside of bed or operating table.
B Transverse diagram showing position of stretcher before lifting patient.
C Transverse diagram showing stretcher after placing patient on bed or table.

FIG. 115.—REMOVING PATIENT FROM STRETCHER TO BED OR OPERATING TABLE.

more or less. If the patient is quite helpless and very heavy, it is advisable to have a second person to assist.

In changing the upper coverings, a fresh sheet and blanket are first spread over, and the others are then slipped away from underneath. It is quite unnecessary to expose any part of the patient n changing the entire bed-clothing.

377. A draw-sheet is used for all patients confined to bed. This is constantly drawn through, thus enabling the patient to lie on a cool spot. When the patient is taking food, the draw-sheet should be drawn after each meal to remove the crumbs, and it should be changed when soiled with discharges. Mackintoshes are used on beds only as a protection to the mattress, and should be withdrawn as soon as they are felt to be unnecessary.

378. Feeding of patient.—Food of a liquid nature should be administered by means of a feeding-cup. If a glass or cup is used it should be only half-filled. Nourishment should be given regularly, in most cases every two hours. If it is necessary to raise the patient's head to administer a drink, one arm should be inserted under the pillow and the head gently raised.

379. Bed-pans and urinals.—The commonest and most useful shapes of bed-pans are the "Circular" and the "Slipper." The round pan is generally used in hospitals. If the patient is not absolutely helpless, one person can give it. Place one hand almost under the buttocks and help the patient to raise himself, then place the bed-pan in position. The handle should be plugged with a rubber cork. Before attempting to remove it, the patient should be lifted right off it. After use, the bed-pan should be at once covered with a china cover, over which is thrown a cloth wrung out of some disinfectant. It is then straightway removed from the ward, and, unless needed for inspection, at once emptied, the pan being thoroughly flushed with cold water.

Urinals for use in bed are in the shape of bottles. They should be removed from the ward as soon as used. Both bed-pans and urinals should be washed once a day with soap and water. Bed-pans and urinals used by enteric patients, however, must immediately be disinfected by washing with cresol solution ; such utensils must be marked "E."

380. Nasal feeding.—In some cases it is necessary to resort to nasal feeding. This is done by means of a tube passed through the nose into the œsophagus. A soft, rubber tube, after being well oiled, is passed into the nostril and straight backwards. The possibility of the tube slipping into the larynx must be borne in mind, but if this accident should happen the patient would at once cough and show signs of urgent dyspnœa. To the end of the tube a glass funnel is attached, and the food, which should be carefully warmed to 100° F. and strained, is poured down in a steady stream, the tube not being allowed to become empty until the entire quantity is given. When the whole of the food has been given, and the funnel is empty, the tube should be withdrawn quickly.

It should be compressed by the finger and thumb to prevent the escape of fluid into the larynx on withdrawal.

381. Care of the dead.—After death, before the muscles of the body become stiff and rigid, the eyes should be closed. When necessary, pads of wet wool should be placed over the eyelids. The limbs should be straightened and the mouth closed. The lower jaw is supported either by means of a roller bandage placed under it, or by putting on an ordinary jaw-bandage.

About one hour after death, the body should be washed from head to foot with soap and water, and the rectum plugged with wool The ankles are tied together with a bandage, fresh dressings are placed on any wound there may be, the hair brushed, and a shroud put on. A clean sheet is placed over all.

CHAPTER VII.

THE OBSERVATION OF THE SICK.

382. Reporting on a patient.—A concise and correct report should be kept, in writing, of all patients seriously ill, noting quantity of nourishment taken, with the times of administration, amount of sleep, urine and stools passed. The temperature, pulse, and respiration must be noted four-hourly, and mention made if any symptom of importance is noticed.

What to Observe: Position, Expression, &c.

383. Note carefully the appearance of the patient and his position in bed. Does he look ill or in pain? Has he a heavy and listless, or wide-awake and anxious expression? Is he pale or flushed, or is there a bluish tinge about the face? Is he well- or ill-nourished? Which position in bed gives him the most ease, *i.e.*, does he lie on his back or is he obliged to sit up to get ease in breathing? Does he lie with his knees drawn up to relax the abdominal muscles, or does he lie on one side more than the other?

Notice character and duration of any pain the patient may complain of.

The Skin, the Eyes, &c.

384. Any scars, ulcers, abrasions, bruises, or discolorations about the skin, any swellings, œdema, jaundice, or any profuse perspiration should be reported. Any rash, redness, or eruption making its appearance on the skin should be carefully noted.

The eyes should be carefully observed and any irregularity in the size of the pupils, or tendency to squint, be reported.

It is important to note pain in or discharge from the ear. In any case of head-injury the escape of blood or clear fluid from the ears should be watched for.

The Digestive System, &c.

385. The presence of sordes on the lips, teeth, and tongue should be noted.

It should be observed whether the tongue is tremulous or not, whether clean or furred, dry or moist, or if any ulcers are on it.

Any difficulty in swallowing should be noticed, also sore-throat, or symptoms of indigestion, such as flatulence, tightness of the chest, pain at the pit of the stomach or between the shoulders, or nausea after eating, together with the exact relation to food. Quantity and nature of vomit should be noticed.

Blood vomited is known as *hæmatemesis*. When blood has been retained for some time in the stomach it becomes partially digested and resembles coffee-grounds in appearance.

A patient who has vomited blood must be kept in the recumbent position, and all food withheld till he has been seen by the medical officer.

It is important to distinguish between blood brought from the stomach, and blood coughed up from the lungs. Blood from the stomach is generally dark in colour, and sometimes partly clotted. It is also frequently mixed with food or traces of food, and is vomited up. Blood from the lungs is usually coughed up, is bright red in colour, frothy, and rarely clotted. (*See* also para. 264 (18).)

Any abdominal pain or distension should be noted.

Excretory System.

386. Stools.—The points to be noticed are their shape, colour, consistency, amount, and whether they contain blood, mucus, pus, or undigested food; the frequency of the motion, and whether there is any pain in passing it. Anything unusual should be kept for inspection.

387. Urine.—The colour of the urine should be observed, also if there is any difficulty in passing it. The patient may be unable to pass urine at all, a condition known as "retention of urine." This must not be confused with "suppression of urine" when no urine is excreted by the kidneys.

The quantity of the urine should be noticed, together with the frequency of micturition, remembering that the normal quantity of urine passed in the twenty-four hours should be about fifty ounces.

Respiratory System.

388. Respiration.—The points to be observed are the frequency and character of the respirations, the *normal number* being from 15 to 18 per minute. The patient should never know his respirations are being counted. If he is conscious of it he may unintentionally alter their frequency. The best way to manage is, after counting the pulse, and without removing the fingers from the wrist, quietly to count the movements of the chest.

389. Cough.—The points to notice about a cough are its frequency, duration, and character.

Expectoration varies in character in different diseases, and also at different times in the same disease. A specimen of sputum should be kept for inspection, and if the quantity seems excessive it should be measured for the twenty-four hours.

Hæmoptysis or the spitting of blood, if it occurs in any quantity, is almost always due to tubercle of lung.

The patient must be kept quiet, in the semi-recumbent position, and small pieces of ice may be given to him to suck. An ice-bag may be applied to the chest.

The Nervous System.

390. Fits most commonly occur in cases of epilepsy, but are a frequent symptom of brain and kidney diseases. The duration and severity of the attack should be carefully noted, and in what part of the body the convulsions begin.

A patient in a convulsion or fit should never be left alone. Care must be taken that he does not injure himself, and that the tongue does not get between the teeth. To prevent this something should be inserted between the teeth to keep them apart.

391. Delirium.—When delirium is present it should be noticed if it is of the low, muttering type, or active and noisy ; also if it is more pronounced during one part of the twenty-four hours than another. It should be observed if the patient picks at the bed-clothes.

392. Sleep.—It should be noticed how long the patient sleeps, and whether his sleep is disturbed, or sound and calm. To encourage sleep, the room should be darkened and the light shaded from the patient's eyes. If a patient does not sleep he may be given a drink of warm milk or some other nourishment if not contrary to instructions, the face and hands may be sponged, the pillows re-arranged, and a hot bottle placed at the feet if required.

The Temperature.

393. The temperature is taken by means of a small, glass, self-registering thermometer known as the "Clinical Thermometer." Before taking a patient's temperature, care must be taken that the index is set below 97° F.

The temperature can be taken in the axilla, groin, mouth, or rectum. It should be taken in the morning and evening before the patient is washed. As the thermometer will register slightly higher when the temperature is taken in the mouth than in the axilla or groin, it is necessary always to take it by placing the instrument in the same place, and at the same hour. When taken in the axilla, the part should be wiped dry before inserting the bulb of the thermometer, and the arm folded across the chest. The thermometer should be left in position for five minutes.

When the temperature is taken in the mouth, the bulb of the thermometer is inserted under the tongue, and the patient made to keep his mouth shut, holding the glass with his lips. The patient should not have had anything cold or hot to drink recently.

When taken in the rectum the bulb should be smeared with vaseline and inserted for about one inch, and held in position.

The thermometer should always be washed in tepid, antiseptic solution before giving it to another patient.

394. The *normal temperature* of the body is 98·4° F. In disease, the temperature may be either above or below normal, the former being much the more common. Patients with a temperature above normal are said to be suffering from *pyrexia*; 102° F. being considered moderate pyrexia, and 104° F. or 105° F. severe pyrexia. If it reaches 106° F. it is called hyper-pyrexia.

Pyrexia varies in character. It may be continuous, remittent, or intermittent. A continuous fever is one in which the fever keeps constantly at a high level. A remittent fever is one in which there is a marked difference between the morning and the evening temperature, but it does not at any time fall to normal. An intermittent fever is one in which for some part of the twenty-four hours there is complete absence of fever.

Fever ends either by *crisis or lysis.* If by the former the temperature falls abruptly, reaching normal in from twelve to twenty-four hours; if by the latter the descent is more gradual, three or four days elapsing before the temperature reaches normal and remains there.

395. Rigors.—A rigor is a most important symptom of which to take note. In some cases a rigor marks the onset of an acute illness. The shivering may be only slight, or it may be most severe, with a general shaking and chattering of the teeth, lasting for some minutes. Note should be taken of the duration and severity of the rigor, as well as the time at which it takes place. The temperature of the patient should be taken, and hot bottles, hot blankets, and hot drinks given during the shivering stage.

The Pulse.

396. Taking the pulse needs long and painstaking practice. It is one of the most important guides with regard to the patient's condition. By it one is able to tell whether the patient is gaining or losing strength.

The *pulse-rate* in health varies from 70 to 80 beats per minute. When counting the pulse, three fingers should be placed on the radial artery at the wrist. The pulse of a sleeping patient may be taken by placing the finger on the temporal artery just in front of the ear.

The frequency, size, compressibility, and regularity should all be noted.

A pulse which, with a stationary or falling temperature, gets quicker day by day, is a very sure indication of a failing heart.

CHAPTER VIII.

THE SERVING OF PATIENTS' FOOD.

397. Intelligent attention to every detail in connection with the serving of patients' food is a most important part of a nurse's duties. Progress in many cases is much influenced by the amount of nourishment taken and this may often depend largely on the way it is served.

One of the most important points in this connection is scrupulous cleanliness in every detail. The cloth covering the tray or table must be spotless, the glass and plate polished and bright, and the arrangement as dainty as possible.

Notice should be taken that nothing has been spilt in carrying the tray, and that glasses are not filled too full. Food intended to be taken hot should be brought to the patient *hot* and not lukewarm; covers must always be used. Small portions only should be put before the patient; a large plateful will often be refused, when a daintily arranged one would have been eaten and enjoyed.

The food must never be kept in the sick room, but brought freshly to the bedside; similarly, the tray or table should be removed from the room directly the meal is finished.

Before bringing a patient his meal, the orderly should see that he is quite ready to commence it. If able to feed himself he should be comfortably propped up in bed, and everything he will require put conveniently to hand. If helpless, great patience and care must be taken in feeding him.

Punctuality in serving meals to invalids, and the strictest accuracy in observing and reporting upon the amount of food actually taken, are very important points.

As a general rule meals should, as far as possible, come as a surprise and not be discussed beforehand; some patients, however, have strong likes and dislikes with regard to food, and these when expressed should never be neglected.

CHAPTER IX.

SURGICAL NURSING.

Two Great Principles.

398. The care of most surgical cases involves the application of two great principles—*cleanliness*, and *rest*.

399. Cleanliness.—By surgical cleanliness is meant something more than ordinary personal cleanliness. It means not only freedom from dirt but freedom from germs. Germs, or microbes as they are called, are present everywhere. They are so small that they are not

visible to the naked eye, and can only be seen when highly magnified by the microscope.

To prevent germs from entering a wound, we endeavour to ensure complete freedom from living germs on everything which may be used during an operation or during the dressing of a wound. Articles that cannot be subjected to sterilization by heat are treated by antiseptics.

Two expressions commonly used with reference to the treatment of wounds are *asepsis* and *antisepsis*. By asepsis is meant freedom from germs, while antisepsis refers to the measures employed to destroy the germs which may be present either in the wound or on the skin.

400. *Sterilization and cleaning of instruments.*—Instruments, except knives, are sterilized by boiling. They are put into boiling water to which one per cent. of bicarbonate of soda has been added, and are boiled for 10 minutes. Knives should not be boiled, as it blunts their edges. They may be sterilized by being wiped with pure carbolic on a sterilized swab, then placed in ether for 10 minutes, or be sterilized in other ways, according to the instruction of the surgeon.

After boiling or sterilizing, instruments are placed in trays containing carbolic lotion, 1 in 60, by means of a pair of sterilized forceps; on no account must they be touched with the hands. Should an instrument be dropped, or touch anything while being conveyed to the tray, it must be re-sterilized immediately.

After an operation the instrument should be rinsed in tepid water, and then scrubbed with a nail-brush in soap and hot water to which a little bicarbonate of soda has been added, after which they are again rinsed in water to remove the soap, and dipped in methylated spirit.

401. *Ligatures and sutures* are made from silk, linen, silkworm-gut, catgut, kangaroo-tendons, silver-wire, and horse-hair, and they are each sterilized in a special manner. Silk, silkworm-gut, and horse-hair can all be boiled.

402. *Bowls and trays* must be sterilized, boiled, or scrubbed before use. If it is impossible to boil them, they should be well scrubbed with soap and hot water, and allowed to stand in 1 in 20 carbolic for twenty-four hours before use.

403. *Towels, gowns, dressings, and swabs* are all lightly packed in tins and sterilized by heating to 212° F., in a steam-sterilizer for twenty minutes. After being sterilized, the tins should be sealed down and not opened till the time of operation. When required, the articles must be lifted by means of a pair of forceps or a sterilized towel, and never touched by the hands. The dressers containing swabs or dressings are only to be opened when required, and their contents conveyed to lotion or to the operator by means of sterilized forceps.

When a tin has been once opened, any of the dressings left over should be re-sterilized.

404. *The hands* of all engaged in surgery require earnest attention; the nails must be kept short, carefully trimmed and clean, and all tags of skin removed daily. When preparing for an operation, the hands and arms up to the elbows should be very thoroughly scrubbed with soap and water for at least five minutes continuously, special care being taken with the nails and between the fingers. Plenty of soap must be used and the water changed three or four times, or, better still, they should be washed under a running tap. The nail-brush should have been thoroughly sterilized, preferably by boiling. After this thorough washing, the hands should be soaked in biniodide lotion, 1 in 1,000, and left wet, or wiped with a sterilized towel. Rings must on no account be worn.

Having thus cleansed the hands, they must on no account touch anything that is not sterilized; should this occur the whole process must be gone through again.

405. Rest.—The second great principle is rest, both local and general. Thus, when the stomach has been operated on, it is kept at rest by not giving it any food to digest. General rest is obtained by keeping the patient in bed, and rest in the case of the limbs is carried out by means of splints, bandages, and other mechanical appliances.

It is the duty of the attendant to see that the splints, bandages, and other mechanical appliances are kept as originally applied. In the case of a fracture, if the limb is not kept still, the ends of the bone will constantly rub against one another, so giving rise to continual irritation, and union may be delayed.

Operations.

406. Preparation of the patient.—Before an operation of any magnitude the patient should go to bed for a day or two, if not already confined there. The day before an operation the patient has a hot bath or is washed all over while in bed, subsequently receiving a change of linen; his skin is then prepared. While the skin is being cleansed, the patient's bedding should be kept away from the part by means of sterilized towels. Unless orders are given to the contrary, the part should be shaved for ten inches round the place where the incisions will be made, and then gently but thoroughly scrubbed with soap and water, afterwards being rubbed over with ether to remove all grease. A compress is then applied, soaked with some authorized antiseptic, according to the orders of the surgeon. This is firmly bandaged on and left till the time of the operation. On the thoroughness with which this preparation of the skin is done depends very largely the healing of the operation wound.

A purgative is usually given on each of the two nights preceding the operation, and on the morning of the operation enemata should be given till the rectum is empty. Two or three may be necessary. Rectal cases require two days of preparation by purgatives and enemata.

On the morning of the operation a specimen of urine should be saved for examination.

Food in a fluid form, *e.g.*, a pint of beef-tea, should be given four hours previous to the operation, but nothing else unless by special orders.

The patient should be clad in a loose, flannel gown, the legs being covered with long, woollen stockings, which should be sterilized.

False teeth should be removed. The patient should pass water before going into the operation-theatre.

407. After-treatment of operation-cases.—The operation-bed should be made up with clean linen, a draw-sheet and mackintosh placed in position, and the bedclothes folded over to one side so that the patient can be quickly put back to bed. Hot bottles should be placed in the bed, and a blanket made hot to cover the patient with on his return from the theatre.

After any prolonged operation, a hot, saline solution should be prepared and ready at hand in case of need, also blocks to raise the end of the bed.

The patient requires watching carefully until he regains consciousness, and if there is a tendency to vomit, as there frequently is on coming round from a general anæsthetic, the head should be turned to one side. A towel and bowl should be at the bed-head for this reason.

A bed-cradle to support the weight of the clothes is advisable in some cases, and should be at hand in case of need.

After all operations, food is withheld until the anæsthetic-sickness has passed off. Thirst is relieved by drachms of hot water, given slowly. The tongue may be kept moist by allowing the patient to rinse the mouth with a little water or soda-water. Special instructions with regard to the after-feeding of the patient will be given according to the nature of the operation, but to no patient will an ordinary diet be given on the day of the operation. Milk or milk and soda-water would in all probability be the only food allowed.

On the evening of the operation the gown should be changed, the patient's hands and face sponged, and the draw-sheet drawn through. On the morning after operation a specimen of urine should be saved for examination.

For the first 24 hours after an operation the dressing should be frequently examined (without in any way disturbing it). Should blood or discharge appear, the dressing will require to be "re-packed" (*i.e.*, a fresh pad of sterilized wool applied outside the original dressing, which must not be disturbed); all antiseptic precautions must be taken. Should this or any other accident happen, such as urine being spilt, the sister or senior N.C.O. should be at once informed, as the dressing may require to be changed.

408. Operating Theatre.—The theatre where the operation is to be performed must be clean and free from dust of a temperature not less than 70° F., and there must be plenty of hot and cold water.

The room and its furniture should be kept clean and free from dust by means of wet cloths rung out of antiseptic solution. All brass and metal-work should be kept polished. All enamelled metal-work, glass, china, tables, and stools are to be cleaned with soap and water, or boiling water with soda, and 1-40 carbolic; floors, walls, and ceiling being similarly treated.

The table upon which the operation is performed is usually kept warm by means of hot water. It should be thoroughly cleansed before an operation and covered with a sterilized sheet. There are in addition other smaller tables for the instruments, dressings, and bowls of lotion, and one for the anæsthetist's use.

409. The after-nursing of cases of abdominal section.—Abdominal section may be performed for a variety of causes, but the nursing of such cases is very similar. If the operation has been prolonged and difficult, the patient may suffer severely from shock. In such a case he must be put back to bed as carefully and quietly as possible, and a pillow placed under the knees, with the head low, one pillow only being used. Hot bottles should be in the bed and the foot of the bed raised. Particular attention must be paid to the pulse. It should be taken and recorded every hour for the first twenty-four hours. The frequency and character of the vomit must be noted. If retching is severe, the wound should be supported by the attendant's hand being placed over the bandage. Note must be taken if urine has been passed or not, if the bowels have acted or not, and whether the patient has passed any flatus by the bowel.

Instructions with regard to the giving of nourishment must be carried out with the strictest accuracy, each feed being recorded on the chart.

Nourishment by the mouth may not be allowed for twenty-four or thirty-six hours, and then probably in very gradually increasing quantities. For allaying the excessive thirst, an enema of normal salt solution, a pint or more, given hot, is frequently ordered; the mouth can be rinsed out with hot water, and the lips moistened from time to time.

Stimulants should be kept near at hand; and if the patient is in an exhausted condition a nutritive enema may be ordered at once.

For uneasiness and pain in the back insert a small, flat pillow. The knee-pillow must be adjusted and changed when necessary.

Abdominal distension must be watched for and reported.

410. Amputations.—After an amputation of either arm or leg has been performed, the stump should, when the patient has been put back to bed, be placed on a small pillow, to which it is secured by a bandage. This helps to restrain the painful muscular startings which sometimes occur in the stump. The stump should be left uncovered by the bed-clothes so that if any hæmorrhage occurs it may be at once detected.

411. Secondary hæmorrhage.—After major operations, hæmorrhage should be watched for during the first twenty-four or forty-eight hours. Indeed, the possibility of such an occurrence should be borne in mind until the wounds have healed perfectly, as "secondary

hæmorrhage" may occur several days after the operation. Any bleeding, however slight, should at once be reported. Should the hæmorrhage be profuse, prompt action will be necessary, and unless a tourniquet has been left in position, with instructions how to use it, an endeavour should be made to stop the bleeding by compressing the main artery between the wound and the heart.

412. Shock is a condition of general depression of the whole system. This condition occurs after severe frights, injuries, and operations. Collapse and prostration are words used to express similar conditions. The symptoms to be looked for in shock are a weak, rapid pulse, a sub-normal temperature, pallor, a pinched look on the face and about the lips, cold and clammy skin, and sometimes nausea. The patient must be placed with his head low. If in bed, the foot of the bed should be well raised, and hot-water bottles and hot blankets applied. An enema of hot, saline solution with brandy is often ordered. Ether and strychnine should be ready for the medical officer's use, and stimulants by the mouth will probably be given.

413. Tracheotomy.—This is usually an emergency operation, and consists in making an opening in the trachea, and inserting a tracheotomy-tube through which the patient breathes. A tracheotomy-tube consists of a tube within a tube, made of silver. The outer tube is provided with a shield and is held securely in place by means of two pieces of tape which are passed through holes in the shield and then tied together round the neck. The inner fits into the outer tube and projects for a short distance beyond the lower end.

The after-care consists in the management of the tube, in feeding, and good general nursing. Constant attention to the condition of the inner tube is necessary, as the mucus and membranous deposits are likely to fill it up and thus cut off the air-supply. At first the inner tube should be taken out at least every four hours and cleaned, unless some immediate difficulty arises, when it must be done at once. No attempt must be made to interfere with the outer tube, the surgeon alone touching that. The air the patient breathes must be warm and moist. A steam-kettle may be used, and gauze ordered to be placed over the tube. Immediately any mucus is coughed up it must be wiped away with small, gauze swabs, which should be immediately burnt. If feathers are used for cleansing the tube, they must be sterilized. The gauze over the tube will require constant changing. The dressing which protects the edge of the wound round the outer tube must be changed when soiled. The temperature of the ward should be kept at about 70° F.

Nourishment should be administered regularly. Sometimes this is a matter of some difficulty. Thickening the milk with arrowroot or corn-flour makes it easier to swallow, but in some cases nourishment has to be administered by means of the nasal tube, or by rectal feeding. The patient must never be left alone. A

second inner tube, tracheal dilators, pilot, and dissecting forceps should be kept in an authorized antiseptic by the bedside.

414. Skin-grafting is employed when a large area of granulation-tissue has to be covered with skin, as after extensive burns. By means of a sharp knife or razor, pieces of skin are pared off the arm or leg of the patient and laid on the granulating surface. The grafts are then covered with prepared tissue to prevent them sticking to the dressing. Those grafts which adhere grow on the granulating surface and become centres from which the skin grows to meet that which is growing from the edges of the wound. The time taken in healing is thus materially shortened.

CHAPTER X.

MANAGEMENT OF WARDS.

415. Annexes.—To render the condition of a ward wholesome, it is necessary not only to regulate its temperature, but also to provide for the ingress of a supply of fresh air at all times, day and night.

The waste-pipes and sinks in the annexes must be properly cleaned and flushed daily. No soiled or infectious linen and no soiled clothing or dressings should be left standing about in uncovered receptacles. All vessels in use must be kept thoroughly cleansed.

416. Ventilation of wards.*—By ventilation is meant the supply of fresh air to, and the removal of impure air from, an apartment.

Composition of air.—Air consists almost entirely of two gases, oxygen and nitrogen : of the former rather more than one-fifth ; of the latter slightly less than four-fifths. There is, in addition, a minute trace of a poisonous gas called carbonic acid, and a small quantity of watery vapour. In the wards of a hospital the air very soon becomes loaded with impurities.

Every individual in the ward is constantly engaged, during the act of respiration, in removing oxygen from and adding carbonic acid gas to the air. The atmosphere is rendered still more unwholesome by emanations from the patients' bodies, their linen, and excreta ; by any foul wounds or soiled dressings, and by the burning of gas, each jet of which consumes many times as much oxygen as a man.

From these facts it will be at once seen how important it is that the personal cleanliness of patients should be constantly attended to, and that all excreta or soiled dressings be removed from the ward without delay. In addition, in order to counteract this continual fouling of the atmosphere, a frequent and thorough changing of the air is necessary.

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* *See also* para. 10, Chap. II, Part I.

417. *Principles of ventilation.*—The principles to be kept in view are :—(i) That the air within the ward shall be kept as nearly as possible as pure as that outside, without chilling the patients. (ii) That the temperature of the ward be maintained at the proper standard, not exceeding 65° F. (iii) That ventilation must be systematic, and sufficiently thorough completely to renew the air in a ward at least three times in an hour.

There are two simple but all-important facts to be remembered in carrying out the principles of ventilatlon :—(1) Air expands when it is heated : from this it follows that, as the air in a room expands, some of it escapes by the nearest outlet. (2) As a result of its expansion, hot air is lighter than cold air : on this account hot air will rise, and cold air being heavier, will fall.

418. *Outlets.*—Foul air escapes from a room by (*a*) the fireplace, (*b*) the windows, and (*c*) ventilating-outlets.

Being lighter than the pure air, foul air will be found in the upper part of the room. Ventilating-outlets are therefore usually placed in the ceiling. For the same reason the windows should be left open at the top to enable the hot, impure air to escape.

The fireplace is a most important aid to ventilation, as when a fire is burning there is a constant current of air leaving the room by the chimney.

419. *Inlets.*—Fresh air enters a room by (*a*) ventilating-inlets, (*b*) the windows.

In hospitals the ventilating-inlets are so arranged that the amount of air entering by them can be regulated and generally diffused over the room, so preventing draughts.

In recently built hospitals the air on entering these ventilators is warmed by coming in contact with hot-water pipes. In the absence of hot pipes the cold air should be introduced above the level of the patients' heads, so that it reaches them after mixing with the warm air of the ward. Windows have already been considered as outlets for foul air ; they also act as inlets for a large quantity of pure air, and should be constantly open at the top. The opening thus caused between the sashes is the inlet. Fresh air will also enter a ward every time the door is opened, and underneath the door even when shut ; but, if this air is from inside the building, the door should not be regarded as a suitable means of ventilation.

Patients frequently complain of draught when the windows are kept open ; the attendant must use consideration and tact as well as firmness, and by the addition of an extra blanket or a hot-water bottle, patients can generally be kept quite warm.

420. *Duty of Attendants.*—Finally, the matter of ventilation requires unremitting attention from attendants on the sick. Neglect of this duty will favour the development or spread of disease, retard the healing of wounds, and generally lower the health of the patients. To test the air of a ward, the attendant should from time to time go into the open air ; on re-entering he will at once be able to detect the impurity or otherwise of the atmosphere.

421. Floor of Ward.—The floor of the ward should be swept every morning and again in the middle of the day. In sweeping hospital floors it is important to raise as little dust as possible; by fastening a flannel over the brush or broom this danger can be almost entirely averted.

When the floors are polished they require to be first swept, then the polish used. This must be applied on house-flannel, on hands and knees, and well rubbed on to a section of the floor, which must afterwards be well dry-rubbed by a heavy-weighted, long-handed brush; the corners being done by hand. Polished floors should be well scrubbed with hot water and soft soap once in six months at least.

422. Dusting.—Dusting should be done twice a day in the wards, with two dusters, a damp and a dry one. The damp one is used first and the dry one for polishing.

423. Walls and Windows.—Walls should be washed down every three months.

The woodwork of windows should be cleaned by washing with warm water and soap. The glass itself is cleaned by sponging with water and methylated spirit and then polishing it with a clean and thoroughly dry duster. This mode of cleaning is not always necessary, for if the glass be wiped over daily with a duster it will generally suffice to keep it in good order. The cloths used should be free from nap or fluff.

424. Stoves.—In cleaning stoves, care must be taken not to soil other things. A good plan to prevent this is to hold a thin strip of wood with one hand against the surrounding wall, while the brush is used with the other hand. The blacklead should be made into a thin paste and applied with the small, round brush over every part that is to be blacked. When the blacklead is dry, the polishing brush should be used briskly until every part of the iron-work shines. The ends of the fire-irons are cleaned in the same way as the stove, and the bright parts rubbed with bathbrick and a piece of leather, or coarse cloth, or burnished.

The best time for cleaning a fire-place is before the fire has been lighted; but, as this can seldom be done in hospital wards, each morning the fire should be allowed to become low in order that the stove may be cleaned before it becomes too hot.

425. Paint.—The paint-work of a ward should occasionally be scrubbed with hot water and soap. Soda should not be used, as it soon destroys the paint (including enamel).

426. Wood-work and Utensils.—Bedside-tables, the boards over the patients' beds diet-trays, and all white wood should be scrubbed with hot water and soft soap. Tumblers and all glass articles should be washed separately, first in warm water with soda and then in cold water. Vessels of tin or white metal are best cleaned by washing with hot water to remove the grease, and then polishing with whitening. In washing knives and forks, care must be taken not to put the handles into the hot water. Coal-scuttles and brasses should be polished with a paste made of finely powdered

bathbrick and water, unless a patent polish is used, and rubbed with a piece of leather or coarse cloth. When the brasses are very dirty they should be washed with hot water before being polished.

427. Beds.—Beds should be thoroughly aired and the mattress turned every day.

To make the bed, a single blanket is first placed over the mattress; over this a sheet is laid, leaving enough at the top to roll the bolster in. It is then firmly and tightly tucked in at the sides and foot, the bolster being rolled in the top of the sheet and the pillow placed on top of the bolster. The top sheet, blankets and counterpane are then spread, tucked in round the sides and foot of the mattress, and neatly folded down at the head. A draw-sheet is used for all patients confined to bed. The width of the draw-sheet is usually half the width of an ordinary sheet, but when a mackintosh is used it should be folded so as completely to cover the mackintosh.

428. Air- and water-beds.—Air- and water-beds are used in certain cases. They are a preventive against bed-sores.

The air-bed is laid on the top of an ordinary mattress. There are several patterns, that used in military hospitals having three compartments, the smaller one of which is put to the head. The air is pumped into the three compartments separately. If filled too full, the bed will be hard and uncomfortable. Two under blankets should be placed over the air-bed, and the bed made in the usual way.

A water-bed is necessarily much heavier than an air-bed. After being placed in position on the bed, it is filled with water at a temperature of 90° F. It must not be filled too full, and it must be emptied before any attempt is made to move it. To test whether an air- or water-bed is filled sufficiently, the orderly should lie down on it and try it.

Both air- and water-beds must be throughly cleaned after use and great care taken to avoid damaging them with pins.

The blankets under the patient covering these beds require to be frequently changed, as they become damp from perspiration.

CHAPTER XI.

FOOD AND COOKERY.

General Instructions.

429. General Remarks.—It is part of a cook's duty to become acquainted with the various cuts or joints into which the carcasses of beef, veal, mutton, and pork, &c., are divided.

He must likewise be able to tell good-quality meat from indifferent or bad meat. In the case of meat, or any other product sent in, which is found to be inferior in quality, or unfit for use, the fact is to be immediately reported to the steward in accordance with the Standing Orders.

430. Meat.—The following hints are for guidance in the matter of detecting good from bad-quality meat :—

Meat may be roughly divided into four classes : (1) Home-bred and killed, including every kind of bull, ox, cow, heifer, sheep, and pig.

(2) Foreign-bred but killed in England, principally beef. This class is generally of good quality, having been well fed. The rigid inspection on arrival in this country is sufficient protection against the importation of diseased animals. There is often a deficiency in fat owing to wasting during the sea-voyage. Occasionally there are signs of bruising or even laceration of the flesh, due to injury from bad weather. Meat in this condition should not be accepted.

(3) Refrigerated meat, chiefly American and Canadian, which is killed and dressed abroad, wrapped in canvas, and hung up in cool chambers, at a temperature of about 36° to 40° Fahrenheit. The meat of this class is generally like that of (2) class, as the animals are killed in prime condition, and the rigid inspection is a guarantee against the importation of unsound meat.

Refrigerated meat differs slightly in appearance from freshly killed meat ; it can be distinguished by :—(*a*) The fat of the meat being pink, owing to staining by the juice of the lean which escapes. (*b*) The outside of the meat presenting a dull, dead colour, when compared with the lustre on the outside of good, fresh meat ; also, occasionally, the marks of the canvas covering being visible. (*c*) The dressing not being always so clean and neat as in English-dressed meat, and the pizzle and root not being always entirely removed.

If there is the slightest suspicious smell to be discovered on the outside, the flesh should be cut into and examined.

(4) Frozen meat, principally mutton, which is chiefly imported from Australia and New Zealand in an actually frozen condition. It can be easily distinguished, before it is thawed, by its hard, cold touch. The fat is not stained as in refrigerated meat. When thawed, it can be distinguished by—(*a*) The outside having a wet, sometimes greyish or, so-called, parboiled appearance ; there will be oozing and dripping of liquid from the meat. (*b*) The general colour of the fat is dull-white. (*c*) The flesh has a uniform pink appearance, owing to the diffusion of the colouring matter of the blood, and is not mottled as in fresh meat.

431. Salted meat.—If there is any doubt as regards salted meats a portion should be tested by cooking, which will often reveal defects otherwise not recognizable.

(1) The salting may be well done, but the parts inferior. Examine those pieces at the bottom of the cask, and compare several pieces to see if there is a fair proportion of good parts of the animal.

(2) The salting may be well done, and the parts good, but the meat old ; here the extreme hardness or toughness and shrivelling is the test. See if the year of salting is on the cask.

(3) The salting may be well done but the meat bad. If the meat has partly putrefied, no salting will entirely remove its softness, and there may be an offensive smell or greenish colour.

(4) The salting may be badly done, either from haste or bad brine. Signs of putrefaction will be present; the meat is paler than it should be and has a bad odour.

432. Inspecting meat.—When inspecting meat, it should be hung up so that it can be seen on all sides without handling. Twenty-four hours after being killed is the best time for the inspection.

The following points must also be attended to:—(1) Quantity of bone, (2) quantity and character of the fat, (3) condition of the flesh, (4) condition of the marrow, (5) age of the animal, and (6) sex.

Percentage of bone.—In lean animals the bone is relatively in too great a proportion; 17 to 20 per cent. may be allowed.

Fat.—The fat is a most important item. The interior of a carcass should show bright, healthy-looking fat. In a fat ox it may be as much as one-third of the flesh; it should be firm, and white or pale straw colour.

Marrow.—Condition of the marrow. The marrow in the hind-legs should be solid 24 hours after the animal has been killed. The colour should be light rosy-red; if dark with spots of black, the animal has been sick or putrefaction has commenced. The marrow of the fore-leg bones is more fluid, otherwise it should present the same characteristics.

433. Beef.—Bull-beef may be distinguished from ox-beef by the size of the erector-muscle, pizzle, and pelvic bones the absence of a plentiful supply of "cod" and "kidney" fat, a general massiveness of the bones and muscles, and almost a total absence of that coating of the fat on the exterior of the carcass which is the characteristic of well-fed ox-beef. The lean will be very course and stringy in texture, dark in colour, with an absence of juice and of marbling by fat. The feel to the finger and thumb will convey an indiarubber-like consistency, instead of the smooth and silky touch of ox-beef, which is also marbled, juicy, and florid-coloured in appearance. The fore-quarter of the bull is very large, the collar or crest requires the whole hand to grasp it, whilst in the ox it can be grasped with the fore-finger and thumb. If the neck has been removed suspicion will at once be aroused.

In the fore-quarter of the heifer or young cow the ribs show the pinkness of youth, but in an old cow they will be white and more bleached as age advances, and there is a general want of fat. The the meat of a heifer is like that of a young ox, and very difficult to distinguish from it; whilst that of an old cow is course, stringy to the touch, dark in colour, and with an absence of moisture. The fat of a heifer or young ox is plentiful on the exterior, coming right to the shoulder; in the cow it is yellow in colour and scanty.

434. Mutton.—Good mutton is of deep-red colour when cut, the fat should be white and firm and should not be coarsely ingrained with the lean. Small-boned mutton is generally the best and most

profitable. The way of detecting the amount of fat on a carcass without cutting it through is to look at the shoulders; if a bluish tint is discernable the proportion of fat is not too great. When joints only are received, if too fat, the butcher should be asked to trim them or to make adequate allowance.

435. Fish.—Fresh fish is firm and stiff, the drooping or not of the tail being a fair criterion on this point. The eyes should be bright and prominent; the gills a bright-red colour. Flat-fish, like plaice, sole, brill, or turbot, keep better than herring, mackerel, or mullet. All fish should have been cleaned, be unbruised, unbroken, and free from smell, when delivered. Cod-fish is considered better if it is allowed to soak in cold, slightly salted water a few hours before it is cooked, as this makes the flesh firmer.

When small flat-fish, such as plaice or dabs, are tendered, a proper allowance of weight should be made for heads, fins, &c.

Stale fish is not only unwholesome, but sometimes poisonous. Fish with the least unpleasant smell should at once be rejected.

436. Fowls.—Fowls are frequently required for the use of the patients in hospital. They ought to be young, fresh, in good condition, and weigh not less than 1¾ lb. when trussed. Signs of age are shown by stiff horny feet, long spurs, dark-coloured, hairy thighs, stiff beak and bones.

There should be no smell or discoloration of the skin. The back generally discolours before the breast. The feet should be limp and pliable, not stiff and dry, which is the sure indication of a stale bird. The condition of the flesh should be firm and not flabby, and the bird should be plump; the breast-bone is sometimes broken across to produce this appearance. There should be some fat, which is a sign of health and good feeding, but there is no advantage in having one excessively fat, as this only wastes away in the cooking and is not always agreeable to a sick person. The flesh is not marbled like that of the ox, but the fat is accumulated in a layer over the body.

From Christmas to April chickens are most difficult to obtain, and consequently during this period of the year greater care and caution should be exercised in inspecting those sent in.

437. Rabbits.—Young rabbits have smooth and sharp claws. Old ones have the claws blunt and rugged, and the ears dry and tough. Seasonable from September to February.

438. Eggs.—The average hen's egg weighs about 2 oz. avoirdupois. In order to ascertain the freshness of an egg, hold it up to the light; when the centre appears to be the most transparent part, it is a sign of freshness. Stale eggs are more transparent at the larger end. Another method is to make a solution of brine (one part of salt to ten of water) and place the egg in the solution. Good or fresh eggs will sink to the bottom whilst the stale ones will float. Stale or small eggs should be rejected.

In using eggs for cooking purposes, such as adding them to other ingredients, poaching, or frying, each should be broken in a clean cup or basin before being used. In this way, bad ones can best be detected.

489. Milk.—Cow's milk enters very largely into all dietaries; every care must be taken to use it when fresh, as, owing to the action of germs, lactic acid is formed after some hours, and the milk becomes sour. The cleaner the milk the longer it will keep fresh and sweet; therefore great care must be taken that the vessels in which it is kept are perfectly clean, and that it is protected from dust (which always contains germs). The cooler the temperature at which it is kept, the longer will the milk remain sweet.

Genuine milk must contain at least 8·5 per cent. of non-fatty solids and 3 per cent. of fat; such a milk, though genuine, would be of poor quality; good milk should yield not less than 12·5 per cent. total solids, and 3·5 per cent. fat; and during the winter months these figures should be 12·9 and 3·8 respectively.

The cream should not fall below 6 per cent.: this may be tested by placing the milk in a long glass, marked with graduated divisions, and reading off the amount of cream that has risen after 24 hours: or a strip of paper may be marked in divisions (tenths and hundredths), and gummed to the glass.

The specific gravity ranges between 1·030 and 1·034 at 60° Fahrenheit.

Good milk should be of a full opaque white, or very slightly yellowish tinge; this is best seen by placing it in a glass on a sheet of white paper. It should have a slight agreeable odour, and characteristic, sweetish taste, without any pronounced taste or smell of any kind.

The chief adulterations are:—(1) the addition of water; (2) the removal of part of the cream, with or without the addition of water; (3) the addition of starch, gum, dextrine, flour, or glycerine; (4) the addition of the so-called preservatives, as bicarbonate of soda, borax, boric, salicylic acid, or formalin. The addition of water lowers the specific gravity, and generally speaking there is a loss of 3 degrees for every 10 per cent. of water added. On the other hand, removing the cream (skimming) raises the specific gravity; so that in milk that has been both creamed and watered the specific gravity may be normal. This test must therefore be used in conjunction with the estimation of the cream present.

On account of the many risks of contamination of the milk, during milking of the cow, during storage, and during distribution to the customer, it is generally desirable to boil, or sterilize, or "pasteurize" it, before use. Milk will be rendered safe for drinking by simply bringing it to the boil for a minute or two, but as many people object to the taste of boiled milk, it is preferable, when possible, not to raise it to the boiling temperature, but to heat it to 160° Fahrenheit for twenty minutes. This is sometimes called "sterilizing" the milk, but it is better called "pasteurizing." A special arrangement is provided, consisting of an outer chamber or jacket, to contain boiling water or steam, and an inner vessel in which is placed the milk. The directions accompanying the apparatus must be strictly followed. The milk should be stirred frequently, to prevent the scum forming on the top. Great care

must be taken that the milk does not become fouled by dust after it has been heated. All parts of the apparatus must be kept scrupulously clean.

440. Butter.—Butter is obtained by churning, either from the milk directly, or from cream that has previously been separated. It should be of a good, rich-yellow colour, pleasant and characteristic smell and taste; the taste may be slightly salt, but should not be in the least rancid or bitter. The amount of fat in butter ranges between 80 and 90 per cent.: the water should not be more than 16 per cent.: the quantity of salt varies considerably, but nowadays much less (generally 2 or 3 per cent.) is used than formerly, other preservatives, such as boric acid, being used instead; of this there ought not to be more than 0·5 per cent. Oleo-margarine, which is purified ox-fat, is largely used as a butter-substitute; but it must be distinctly labelled as such, and must not be used to adulterate butter.

Cooking Methods.

441. Roasting.—Meat and poultry intended to be roasted must, after being properly trimmed, or trussed, be hung before a sharp fire, or placed in a very hot oven, for the first fifteen minutes, whereby a thin, brown crust is form on the outside which prevents the escape of the nutritive juices. This is especially necessary in the case of red meat such as beef and mutton, but it also applies to white meat such as veal, pork, and poultry.

After this the heat must be reduced, or the meat must be drawn back so as to allow it to cook more gently. Veal, lamb and pork should, after the preliminary stage of quick roasting, be cooked by moderate heat, because these take somewhat longer to cook than other meats, and must therefore be cooked more gently. Whether roasted before the fire or in the oven, the basting must be carefully attended, as this renders the meat more juicy and tasty. Either butter or dripping may be used for the purpose, but in the case of poultry, the former is recommended.

442. Time required for cooking meat.—No hard and fast rule can be laid down as to the exact time required for cooking a joint or bird, because this depends greatly upon the size and the age of the animal or bird. As a rule fifteen minutes to the pound is allowed for red meats such has beef and mutton, and twenty minutes to the pound in the case of white meat, such as veal, pork, or lamb. In every case allow fifteen to twenty minutes over and above the specified time.

443. Baking.—The main difference between baking and roasting proper is that in the former case the cooking-process is performed in closed vessels, ovens, or other compartments of that description, in the latter before an open fire.

Baking, like roasting, is cooking by means of dry heat, or dry, heated air. The heat is obtained from close fires, coal or gas, or from steam at a high temperature externally applied, as is sometimes the case in so-called bakers' ovens. As before mentioned,

meat can be roasted in ovens, as is mostly the case in large institutions such as hospitals, infirmaries, prisons, &c.; this is known as oven-roasting. Unless the ovens are well ventilated, and are kept clean, the fumes given off by the meat are apt to affect its flavour, and it will not be found so crisp on the outside as that roasted before an open fire. Ovens are chiefly adapted for baking bread, pastry, cakes, and certain puddings.

444. Boiling.—Boiling, or cooking in the boiling liquid, is one of the most common forms of preparing food.

There are two distinct objects attained in adopting this process of cooking, which produce different characteristic results; the first being to retain the nourishing juices, and the second to extract the goodness of the materials used, as is the case when preparing stock, soups, or broths.

To retain the nourishing juices when meat or poultry is to be boiled, it must not be put into the pot or vessel until the water, which should be seasoned with salt, and if possible vegetables, is actually boiling. The article thus added must be allowed to boil briskly for at least ten minutes; for here, as in roasting, the heat must be great enough to harden the external portion and so retain the nourishing juices. This hardening process must not, however, be carried to excess, and after the preliminary stage of actual boiling the heat must be reduced to that of simmering. In all ordinary cooking it must be remembered that simmering heat, which is the middle point of culinary heat, is more effective than violent or fast boiling.

To extract the nourishing juices the materials used must be put into cold water and then be brought slowly to the boil. After removing the scum, the cooking process is continued by slow, *i.e.*, simmering, heat until the preparation is sufficiently cooked in the liquid, which must contain practically all the goodness of the materials used.

The average loss in boiling meat is about 25 per cent. of its weight. About 20 minutes to every pound of meat, and 20 minutes over should be allowed for boiling or steaming. The following parts of meat are the best for boiling, viz., the brisket and round of beef, legs and necks of mutton or lamb. Chops are also suitable for boiling or steaming, and are considered better if so cooked for invalids. Chickens are more digestible when boiled than roasted.

445. Boiling vegetables.—All green vegetables must be boiled fast in slightly salted water. Old potatoes should be put into cold water and allowed to boil slowly till tender; in other respects the above rules apply equally to the cooking of vegetables.

446. Steaming.—Steaming is cooking in moist heat or heated vapour, *i.e.*, cooking over or surrounded by boiling water. Although in all respects the results of steaming are the same as in boiling, the former process is more gradual (slower) than boiling, and is therefore for many reasons to be recommended. Steaming is regarded as one of the most satisfactory and covenient methods of cooking many articles of food, and is especially recommended in invalid-

cookery, and for large institutions where cooking on a large scale has to be daily performed.

Beside being economical, steaming is also a simple process. The best flavour is obtained and the largest proportion of nutritive juices retained by this method of cooking, without loss of substance. The actual loss in weight of meat cooked by steam is slightly less than by boiling. The rules given for boiling are equally applicable to steaming, the preparation of materials being also identically the same as for boiling.

Meat, fish, potatoes, &c., are usually cooked by steam. In all such cases the water or other liquid such as stock, liquor, &c., is to be brought to the boil, and after a period of from 15 to 30 minutes, the steam should be somewhat reduced so as to allow the contents of the steamer to cook more or less slowly till the articles to be steamed, solid or liquid, are quite done and fit for serving. Exception to this rule is made in case of potatoes, full steam being required for these during the whole process.

447. Stewing.—This may be termed an auxiliary of the boiling process. Stewing, in reality, is cooking in a small amount of liquor at a low temperature, and is therefore an improved form of boiling, and forms one of the most popular cookery methods on the Continent. By this method, otherwise coarse or tough parts of meats can be made tender and nourishing, and as the gravy or sauce in which the meat, &c., is stewed is always served up, it naturally contains the good properties of the chief ingredients employed. More nourishment can thus be gained by this mode of cooking than by any other, so that it becomes the most profitable as well as the most useful form of preparing food.

For certain stews, the meat—especially red meat—is par-fried in butter or dripping before being actually stewed, whereby a distinctive development of flavour is obtained. Special care should be taken to avoid the meat being stewed from becoming overdone ; it must only be cooked until tender, and not to a rag. This fact is often overlooked by cooks. A little vinegar sprinkled over coarse meat before cooking, considerably aids the process of rendering it tender.

448. Frying.—This process of cooking may be divided into two methods :—(*a*) deep or wet-frying, (*b*) dry-frying.

(*a*) *Deep-frying.*—Deep-frying is cooking by immersion in hot fat or oil, at a temperature which must be nearly twice that of boiling water (which is 212° Fah.). There must therefore be enough fat (clarified dripping, lard, suet, or oil) to cover well the articles to be cooked. The fat or oil must be hot enough to produce similar results as in roasting ; that is, to encrust or brown the surface of the articles so cooked. Unless the fat is heated to the correct degree of temperature, frying becomes a failure, as anything put into fat or oil which is barely hot becomes sodden, greasy, unpalatable, and often uneatable. It is therefore of very great importance that the frying fat should be of the proper degree of heat before the articles are put in it to fry. When fat or oil is at the right temperature for frying it

should be still, not bubbling, and a light-bluish smoke or vapour should rise from it.

Deep-frying is best adapted for fish, croquettes, rissoles, or fritters. With the exception of paste-coated things, or fritters, articles to be fried must be either dipped in batter, coated with flour, or egged and crumbed before being immersed into the hot fat. It is also most essential that anything that is fried should be carefully drained on paper or a cloth before being served in order to free it from excess of fat, which is most objectionable, particularly so in dishes intended for invalids.

The best fat for frying is that obtained from beef-suet, lard, or mutton-suet. The latter is not so good as beef-suet. The dripping from roast meat, and the fat from the stock-pot or from stews, should be saved and added to the other bulk of raw or cooked fat when it is being clarified.

(*b*) *Dry frying.*—Dry-frying, also known as sauté-ing or pan-frying, is best adapted for cutlets, fillets, steaks, chops, bacon, kidneys, liver, eggs, etc. Only a small quantity of fat must be used, really only just sufficient to prevent the articles so cooked from burning—just enough barely to cover the bottom of the pan in which the frying is performed. Butter is the most suitable fat to be used for this purpose. It must be allowed to get thoroughly hot, but not burning, before commencing to fry. Frequent turning to prevent hardening or burning, especially in the case of meat, is essential for this mode of cooking. Steak-tongs should be used for turning the articles being cooked, a fork should not be so employed as the punctures made by it allow the juices to escape.

449. Grilling.—This is known as the quickest cooking process; it is sometimes called broiling. A clear fire, preferably of coke or coal, is the great essential to its success. Grilling is to cook in front of or over a fire by the help of a gridiron or grill. Mutton chops, cutlets, kidneys, steaks, fillets, split and skewered pigeons, slices of cod, haddock, whiting, and soles, etc., can be cooked in this manner. Fish must always be well done. The gridiron must be kept clean, and well greased every time it is used. The articles to be grilled must be placed between or over the grill. Frequent turning is most necessary. From ten to fifteen minutes are required to cook a moderate-sized chop or steak. They should be juicy when grilled and not allowed to cook dry.

450. Directions for carving.—All meat, whether roast, boiled, or steamed, should be carved as economically as possible. Joints of meat, such as a leg of mutton or lamb, shoulder of mutton or lamb, ribs of beef, or sirloin of beef, should invariably be cut through to the bone, so that the richer juices which lie near the bone may be served to the best advantage. Neatness in carving must at all times be aimed at, for a joint which is mutilated and hacked to pieces instead of being cut into neat slices, is not only wasteful, but spoils the appearance as well as the enjoyment of an otherwise well-cooked and wholesome meal.

A carving knife and fork, and a steel wherewith to sharpen the knife, are all the tools needed. If the knife and fork are properly handled, there is no need to touch the meat with the fingers, as is too often the case.

(*a*) *Beef.*—In small hospitals the parts sent for roasting are generally the middle and chuck ribs (the middle has four, and the chuck three ribs), or part of them. In this description of joint the bones should be cut out, broken and placed in the soup, and the meat then rolled, skewered, and tied with a strong string. If baked, the meat should have a piece of greased paper placed over it. In carving for distribution, the meat should be cut in slices; if, however, the joint is roasted with the bone, the meat should be removed in one piece from the bone by inserting the knife under it, close to the bone; the bones should be used for soup.

When the buttock and mouse-buttock are supplied for boiling, the meat should be cut when raw from the bone and then cut across in pieces two inches thick.

(*b*) *Mutton.*—Mutton should be carved into rather thicker slices than beef, but not too thick.

Fat, both here and in beef, should be evenly distributed, allowing a small piece or slice for each diet or ration.

In carving a leg of mutton, the leg should be held in position with a carving fork, rounded side uppermost. The knife should be carried sharply down across the centre of the joint, and slices taken from either side. The fat should be sought near the tail-end and distributed as required. The better done part of the joint is the knuckle-end, and slices should be taken from here and apportioned as necessary.

In a shoulder of mutton, the meat, before being cut up into diet-portions, should be removed from the bone in the following way:—Cut the meat off in one piece from the under part of the blade-bone by running the knife close to the bone; then turn the joint over and cut down on each side of the ridge-bone; then run the knife up under the meat close to the blade-bone; there will only remain a few pieces round the shank-bone, which should be cut up and distributed among the diet-portions. The meat should be cut in slices across the grain.

If a neck of mutton is roasted, it should be trimmed and a great part of the fat removed. The scrag-end should be boned, rolled, and tied round, the bones being put into the soup. For broth, the neck of mutton should be divided into chops; for convalescent diet, they should be skewered and tied up, and boiled in the broth.

Recipes and Directions for Cooking.

451. Stock and stock-pot.—It is most important that a stock-pot should be kept going daily in every kitchen. The object of a stock-pot is to produce a nourishing broth or liquor, which is used for various purposes instead of water, but mainly for gravies and soups. A large boiling-pot, a copper boiler, or steam vessel can be used for this purpose, and it should be provided with a tap.

Into it are put all kinds of bones from meat (provided they are fresh), and trimmings of meat. The bones must be chopped small before they are put in the stock-pot or cooking-vessel; either cooked or raw bones and meat can be used. To these the necessary quantity of cold water is added (average quantity being three pints of water to one pound of bones and meat). The whole must then be allowed to come slowly to the boil, when the scum which rises to the surface must be carefully removed. Fresh soup-vegetables (not potatoes), such as onions, carrots, turnips, and also a small cabbage if possible, previously washed, cleaned, and cut up, are next added. Allow about four hours of gentle boiling. During the process of boiling the scum must be removed occasionally, but the fat rising to the surface must not be removed until the stock is finished. A little salt should be added with the bones, &c., as this will help to bring up the scum and other impurities more quickly. After this the stock should be strained and used as directed.

NOTE.—*In warm weather, stock should be made without vegetables, or it will turn sour. Vegetable flavouring can be added as required.*

452. Fish-stock.—Put the skin, bones, and trimmings of fish in a saucepan, and cover it with milk and water in equal quantities; add pepper and salt to taste, also a slice of onion and carrot, a sprig of parsley, and a blade of mace. Simmer for about half an hour and strain; it is then ready for use.

453. To clarify fat.—Ingredients in the following proportions should be used, viz., 7 lb. fat (beef-suet or mutton fat) to 1 pint water. Cut the fat in small pieces of even size, and remove the skin or sinews; put the fat into a large stew-pan with the cold water. Boil it, stirring occasionally until the liquid is quite clear and the pieces of fat appear crisp. Allow it to cool a little, and then strain it into a basin containing a little cold water.

454. Beef-tea.—1 pint water (cold), 1 lb. lean beef, ½ teaspoonful salt.

(*a*) *Quick method.*—Remove all fat, sinews, and skin from the meat, then shred the meat finely, put it in a saucepan with the water and salt, and let it soak for 15 minutes; put the saucepan over a very moderate heat, and stir with a fork for half an hour; strain through a fine strainer, add more salt if necessary, and serve hot.

(*b*) *Slow method.*—Remove all fat, sinews, and skin, and shred the meat finely, put it in a jar with the water and salt, stand the jar in a saucepan of simmering water, or put it in a cool oven for two or three hours. Strain; remove any fat with kitchen paper, and serve.

(*c*) *Raw beef-tea.*—1 oz. finely shredded, lean beef, 1 tablespoonful water. Put the meat and water into a jar, and stand the jar in a warm place for one hour; strain and serve in a coloured glass or cup.

455. Iced beef-tea.—Beef-tea made by either the slow or quick method can be iced. Allow the beef-tea to get cold and put it in a

pewter pot or earthenware basin. Place this in a pail surrounded with crushed ice and salt, and let it stand for about 40 minutes. At the end of that time stir up the beef-tea and beat up for several minutes; allow it to stand for another 10 minutes and repeat this operation two or three times until it appears to be frozen and is quite smooth.

456. Beef-tea with oatmeal.—Mix a tablespoonful of well-cooked oatmeal with two of boiling water; add a cupful of strong beef-tea, and bring to the boiling point. Rice may be used instead of oatmeal. Add salt and pepper to taste, and serve with toasted bread.

457. Beef-tea jelly.—Soak half an ounce of gelatine in water, heat up nearly a pint of strong beef-tea, or mix a small 1 oz. pot of essence of beef or extractum carnis with three-quarters of a pint of hot water. Drain the gelatine, melt in a small stew-pan and add to the beef-tea when quite dissolved. Strain into a wetted mould and stand in a cool place till firm. Un-mould and serve as required.

458. Beef juice.—Place half a pound of lean, juicy beef-steak on a griller over a clear, hot fire; heat it through without actually browning; cut it into strips; press out the juice with a lemon-squeezer into a hot cup, add a little salt, and serve with toasted slices of bread.

459. Mutton-broth.—One lb. scrag-end of mutton, 1 quart of water, 1 dessert-spoonful of pearl barley or sago, 1 clove, 6 peppercorns, 1 teaspoonful of chopped parsley, salt to taste.

Take the meat off the bones and cut into dice. Trim off the fat and put the meat and bones into a saucepan with the water; add the salt and bring slowly to the boil. Skim well. Add the rest of ingredients. Simmer gently for about three hours, skim again, then add the parsley. When cooked remove the bones.

Note.—If vegetable flavouring is allowed, cut up a small onion, half a small carrot, and a turnip, and cook them in the broth. Blanch the barley before using; chop finely about 1 teaspoonful of the cooked meat, and add it to the broth before serving.

460. Chicken-broth.—One small chicken, 1 quart of water, 6 peppercorns, 2 cloves, 1 onion, 1 dessert-spoonful of chopped meat, 1 teaspoonful of parsley, 1 ounce of blanched barley, pepper and salt to taste.

Cut the chicken into small pieces, put it into a saucepan with the cold water; simmer gently for about three hours; season and strain. If liked, an ounce of barley or tapioca may be cooked with it. A small, chopped onion would also make it more savoury.

461. Filleted fish.—Fish should, if possible, be filleted from the bone. This is done by first removing both skins, cutting off the head, making a cut down each side of the backbone, and then running the knife under the flesh close to the bone. Each sole will make four fillets, which should be placed in a previously buttered baking-dish. A piece of buttered paper is then placed over the fish, which is baked in the oven from 10 to 15 minutes. Small

haddocks and large whiting are best filleted and cooked in the same way as soles. Slices of cod can also be cooked in this way. (See also other methods.)

462. Boiled fish.—When cod, haddock, ling, &c., are to be boiled they should be cut into slices when raw, and each slice rolled and tied round with string, which is removed when the fish is dished up. This should be served with a plain white or parsley-sauce.

463. Boiled whiting.—Put the whiting into a saucepan of hot water flavoured with vinegar and salt. Cook gently for about six minutes. Do not allow the water to boil or the fish will break. Try with a skewer to see if it is cooked. Drain and serve on a hot plate.

464. Fried fish.—Fish to be fried is best filleted (except cod which can be fried if cut into slices); the fish must be dried as far as possible in a cloth, and then be dipped into batter (frying batter) or else be egged and crumbled. There must be sufficient fat in the frying-pan well to cover the fish during the whole process of frying, and the fat must be boiling-hot before the fish is put into it (see instructions for Frying).

465. Fried sole.—Wash, wipe, skin, and trim the sole. Dip it lightly into flour, and season with very little pepper and salt. Egg and crumb the sole. Fry in boiling-hot fat. Drain it carefully and serve hot.

Note.—A more simple way to fry a sole is to dip it into milk and then into flour; then fry to a golden-brown in hot fat.

466. Fried filleted plaice.—Fillet the plaice (remove the black skin), put a little salt, pepper, and lemon-juice on each fillet; roll up or leave them flat, then brush over with beaten egg and cover with bread-crumbs, fry in boiling fat, drain on a cloth or paper, and serve.

467. To steam fish.—Skin the fish (sole or whiting), point the tail, remove the eyes, and cut off the fins; then sprinkle over the fish a little salt and a few drops of lemon-juice.

Have a steamer or saucepan of boiling water ready; put the fish in the steamer or on a plate or colander over the saucepan, and steam until the flesh will come easily from the bone (about 20 minutes is usually sufficient); put the fish on a hot plate, pour over it enough white sauce to cover the fish, and serve hot.

Note.—Slices of cod are also suitable for steaming, and are prepared in the same way as above directed.

468. Fish-cakes.—Half pound of cooked fish (cod, whiting, haddock, or other white fish), 2 oz. mashed potatoes, ½ oz. of butter, one yolk of egg, pepper, and salt.

Free the fish from skin and bones, and chop the meat finely. Melt the butter in a saucepan; stir in the fish and potato, and bind with the yolk of an egg. Season to taste. Form into small, round, flat cakes. Egg and crumb them. Fry in very hot fat, drain carefully and serve on a hot dish.

469. Fricassee of fish.—First cook the fish in salted water flavoured with a blade of mace and a sprig of parsley. Remove

the skin and bones and divide it into small portions. Make a white fish-sauce. Season it with lemon-juice, nutmeg, pepper, and salt. Put in the pieces of fish and heat up. Serve with plain boiled rice. If cooked fish is used, put the bones and skin into the water and simmer for ten minutes with the spices, then make the sauce as directed.

470. White fish-pudding.—6 oz. of cooked fish, 1 oz. soft bread-crumbs, one egg, mace, nutmeg, salt, pepper, and 2 oz. of butter.

Chop or mash the fish and warm it up in the butter, add the bread-crumbs, previously soaked in half a gill of milk or cold stock. Season with salt, pepper, a pinch of ground mace, and a grate of nutmeg, then add the beaten-up egg and mix well. Steam in a buttered mould one hour, or bake in a tin buttered and coated with bread-crumbs for half an hour.

471. Chops and Steaks.—Both chops and steaks are best if broiled on or between a griller in front of or over a good fire (coal coke, or gas). When this is not possible, they should be broiled, *i.e.*, dry-fried in frying-pans, adopting the following method :—Slightly trim the chops from superfluous fat, and flatten a little with a bat: the same applies to steaks. Use a clean and dry pan ; heat it over the fire and put in a little dripping or butter (barely enough to cover the bottom of the pan) ; when hot, put in the meat and let it cook, *i.e.*, broil, rather quickly so as to brown the surface of the meat ; then turn it (avoid piercing the meat with a fork or knife, or the juices will escape) and let the other side get browned likewise. After this, allow the meat to cook somewhat slower till done. Chops and steaks of moderate thickness require from fifteen to twenty minutes to cook—they must not be over-done and every care must be taken that the meat is juicy when served.

472. Steam chop.—Loin-chops are best: trim off the fat and roll up the end, which may be skewered. Place it on a small plate and put it in a stew-pan containing stock or seasoned water, also a sprig of thyme and a little parsley. Cover the pan, and cook thus for half an hour or longer till the meat is tender. Serve it with mashed potatoes.

473. Minced Mutton.—Remove the bone and fat from a mutton chop, and mince the remainder very finely. Melt ½ oz. of butter in a small stew-pan ; when hot put in the meat and cook very gently for 10 minutes. Season very lightly with salt and pepper, and serve with small fingers of toasted bread or dry biscuits.

474. Beefsteak-balls.—Scrape the required quantity of lean beef with a sharp knife, so that there is nothing left but the tough fibres ; to each half pound of meat add the yolk of one egg, season with salt and pepper, and mix well. Shape into balls of even size. Use a little flour or bread-crumbs for shaping. Melt some butter or dripping in a frying pan ; when hot put in the meat balls, and fry to a golden brown. Serve with a little thin, brown sauce.

475. Roast and baked fowl.—Previous to cooking, the fow must be plucked, singed, and drawn. To draw the fowl, lay it back-downwards on the table ; cut a slit in the skin of the neck, leaving

enough to form a flap; through this opening insert the middle finger and loosen the entrails, doing this carefully and thoroughly so that less trouble may afterwards be met in drawing the bird. Next, cut off the vent and draw the fowl carefully, taking out all the entrails. Special care must be taken to avoid breaking the gall-bladder as this may ruin the bird by imparting a very bitter taste to the flesh. The inside must then be carefully wiped out, as also the flap of skin at the neck. Lastly, dip the legs in boiling water, scrape them, and cut off the claws, also the tips of the pinions.

A fowl to produce 1 lb. of meat (or two diets) should weigh, when dressed and drawn and ready for cooking, not less than 1½ lb. and not more than 1¾ lb. in its raw state. It should be roasted whole, and afterwards divided. But if one portion of a fowl only is required, it should be cut from the raw fowl, covered with buttered paper, and either baked or roasted. In baking fowls, the oven should be hotter than for meat. If a fowl has been once cooked, to make it hot again place it on a plate in a basin, with very little water under the plate; it should be covered over with a little butter and heated in the oven for 20 minutes.

476. Gravy.—A little hot gravy should always be poured round each portion of roast or baked meat and poultry. To make gravy, proceed as follows:—Pour off the fat from the pan in which the roast joint or fowl was cooked; strain this fat (the excess should be kept for further use); then add the required quantity of stock or bone-liquor, stir over the fire so as to blend the whole, season lightly with salt and pepper, boil for 5 minutes, then skim and strain.

477. Boiled chicken.—Draw the chicken for boiling in the same way as for roasting. To truss, cut off the legs at the knee-joint; then loosen the skin over the legs, and force the lower part of the leg under the skin; put a skewer through the wing, upper part of leg, body, other leg, and wing; tie a piece of string round the "parson's nose," then round the lower part of the chicken so as completely to close the opening. Put the chicken into rapidly boiling stock, boil it for five minutes; then let it simmer for 20 minutes to each pound and 20 minutes over; lift the chicken out of the stock, drain it well, put it on a hot dish, and remove skewer and string. Cut it up into portions and serve with plain, white sauce, or with egg-sauce, as may be ordered. If served plain, a little of the stock or liquor should be poured over each portion.

478. Rabbit, boiled and roast.—Same as for chicken.

479. Stewed rabbit.—It should be well washed to remove any congealed blood, then wiped clean and cut into pieces. An onion should be added for flavouring, and a little dried herbs. Place the pieces of rabbit in a stew-pan with sufficient cold water to cover; add the onion cut up small, a few herbs, pepper and salt to taste, and let it simmer gently from one to one and a-half hours according to size. About fifteen minutes before serving, skim off all the fat, make a little thickening of flour and water, pour in and stir till it boils. A small piece of fat bacon or salt pork will greatly improve the flavour.

480. Stewed tripe.—One lb. of tripe, 1 onion, ½ pint of milk, ½ oz. of flour, pepper, and salt.

Blanch the tripe and remove all fat, and cut into square pieces. Put the tripe, the onion (chopped), and the milk into a saucepan. Season with pepper and salt. Simmer gently for two hours. Blend the flour smoothly with a little cold milk and pour it in. Stir until it boils up, let the whole simmer for ¼ hour and serve very hot.

481. Savoury suet-dumplings.—To each ½ lb. of flour, take 4 oz. finely-chopped beef-suet, 2 eggs, ½ teaspoonful of baking-powder, ½ teaspoonful sweet herbs, 1 tablespoonful of chopped parsley, salt and pepper to taste. Mix the dry ingredients in a basin, and moisten with the egg previously beaten up and mixed with a little milk or stock into a fairly stiff paste. Make up into small balls, and boil or steam them for about ¾ hour in stock or water. These dumplings can be served with gravy or white sauce.

Sauces, &c.

482. Plain fish-sauce.—A plain sauce can be made of the skin, bones, and trimmings by boiling them in a little water with a slice of onion, a sprig of parsley, and salt, and then straining.

483. White fish-sauce.—To be served with baked, steamed, or boiled fish. 1 oz. of butter, ½ oz. of flour, 1½ gills of milk or fish-stock, pepper and salt, 1 teaspoonful of lemon-juice.

Rub the butter into the flour until quite smooth, put it into a saucepan with the milk and stir until it boils. Season with pepper, salt, and lemon-juice, cook for at least 10 minutes and strain. Pour this over the fish with which it is served.

484. Anchovy-sauce.—Take a pint of white sauce, or of melted-butter sauce, and mix whilst hot with an ounce of essence of anchovy. (A few drops of lemon-juice may also be added.) This sauce is served with boiled or fried fish, and should always be sent to table in a sauce-boat and not poured over the fish.

485. Melted-butter sauce.—Two oz. of butter, 1½ oz. of flour, about 1¼ pints of cold water, salt.

Melt the butter in the saucepan, stir in the flour, add the water gradually (if it is to be served with fish, use fish-stock in place of water), stir, bring it gently to the boil, and season with salt.

This sauce is served usually with boiled vegetables or with boiled fish.

486. White sauce.—1½ pints of milk, ½ pint of ordinary stock, 1 onion, 1 clove, 2 oz. of butter, 3 oz. of flour, 6 peppercorns, 1 bay-leaf, a pinch of salt, nutmeg.

Boil the milk in a saucepan, peel the onion and stick the clove in it, put it into the milk with the bay-leaf and peppercorns. Stir the flour into the butter previously melted in a saucepan. Cook without browning for a few minutes, then moisten with the stock and boil up, then add the milk, &c. Let all boil until the flour is thoroughly cooked, this will take about ten to fifteen minutes. Take out the onion, bay-leaf, and peppercorns. Add a pinch of nutmeg, if desired, and one of salt. If it is not smooth, pass it through a sieve. Should

a richer sauce be desired, a small piece of fresh butter or a little cream may be worked in after the sauce is strained, but it must not boil again. This sauce is suitable for boiled mutton, chicken, or rabbit.

Another white sauce which is commonly used for boiled vegetables, such as cauliflowers, artichokes, onions, &c., is made as follows:—Melt a piece of butter, the size of a walnut, in a saucepan; when melted add a spoonful of flour and thoroughly mix a mixture of half stock and half milk to make it of a consistency of cream. If too thick add a little milk or stock gradually to thin it: the sauce should be of a consistency to cling to the article of food. Then add sufficient milk and boil, and pour over vegetable and serve.

487. Caper-sauce.—Make ½ a pint of melted-butter sauce as directed, chop coarsely 3 tablespoonfuls of capers, add these with a tablespoonful of vinegar to the sauce, boil for five minutes and serve. This sauce is usually served with boiled mutton or with boiled fish.

488. Parsley-sauce.—Heat up a pint of white sauce. When quite hot, stir in the chopped parsley (add one teaspoonful of lemon-juice if liked), boil for five minutes and serve.

N.B.—The parsley after being chopped should be put in the corner of a cloth and washed under the cold-water tap, and squeezed dry before it is put into the sauce.

489. Egg-sauce.—One pint of white sauce or melted-butter sauce, 2 eggs, a few drops of lemon-juice.

Boil the eggs for fifteen minutes, put them into a basin of cold water to cool, take off the shells and chop the whites of the eggs not oo finely. Heat up the sauce, and when ready stir in the chopped whites. A few drops of lemon-juice or vinegar may be added if desired.

490. Brown-sauce.—1¼ pints of gravy or rich stock, one onion, one carrot, 2 oz. of butter or dripping, 1½ oz. flour, ½ oz. of mushroom-ketchup, ½ oz. of vinegar, salt, and pepper.

Peel the onion, scrape the carrot, cut up both into small pieces; melt the butter or dripping in a saucepan and when hot add the vegetables and flour, stir over the fire until brown, put in the vinegar, ketchup, and gravy, and continue stirring up until it boils, then skim well, and allow it to simmer for twenty minutes. Strain and season to taste, re-heat and skim, and serve as required.

491. Fried potatoes.—Wash and scrub the potatoes, peel them thinly, cut them lengthwise into slices, then cut the slices into long, thin strips, keep them in cold water until ready to fry. Have a frying-pan with sufficient hot fat (lard, dripping, or oil) to cover the potatoes. Drain the potatoes carefully and fry in the hot fat until they are a light brown colour; lift them out and drain them well on a cloth or paper and serve. Frying is one of the best methods by which to cook potatoes.

492. Brussels sprouts.—Trim the sprouts by removing the outer leaves, and wash them in cold water. Add a tablespoonful of salt to the boiling water, put in the sprouts, and keep them boiling rapidly, without a cover, until the stems are soft (usually about

twenty minutes); then melt 1 oz. butter in a saucepan for each pound of sprouts, add the sprouts to it, strain, season with salt and pepper, then shake them well, dish them up and serve hot.

NOTE.—*Soda is often added to preserve the colour of vegetables; this is quite unnecessary if vegetables are boiled rapidly and served at once. Soda may cause indigestion and therefore should never be added in invalid-cooking.*

493. Baked tomatoes.—Cut the tomatoes in halves, crossways, scoop out a little of the pulp, and mix in with bread-crumbs, grated cheese, chopped parsley and a little butter. When these ingredients have been well mixed, fill the tomatoes with them, place them on a buttered tin, season with a little pepper and salt, and bake in a hot oven from fifteen to twenty minutes.

494. Spinach.—For each 1 lb. of spinach take ½ oz. of butter or dripping, salt, and pepper.

Pick all the stalks off the spinach, wash it well in several waters and put it into a stew-pan with the drops of water that hang to the leaves; let it boil till thoroughly tender, then rub it through a wire-sieve. Put it back in the stew-pan with the butter and a tablespoonful of cream, pepper and salt, mix well until it is thoroughly hot, then serve with pieces of toast around it.

Note.—Additional water is not necessary to cook spinach if it is properly washed and picked, and the leaves put in the stew-pan with the water hanging to them.

495. Cauliflower.—Select a cauliflower with a firm, close head, wash it and trim off nearly all the leaves (a few left will be a protection to the flower), soak in salted water for one hour in order to displace any insects, &c., put it into boiling water and cook till quite tender, which will take from 20 to 30 minutes. When it is plainly boiled for table, split the stem across in opposite directions, so that it will cook as quickly as the flower, place it in the saucepan with the head downwards so that if any scum arises it may be removed easier from the surface of the water, and at the same time the flower will be kept much cleaner. To test if it is sufficiently cooked, press a little of the leaf with the fingers and if soft take it out on a hair-strainer or cloth, trim off all the stalk, reverse it upon the dish so that it is in the same position as when growing and serve up covered with the white sauce referred to in para. .

496. Carrots.—Should be washed clean, scraped, and cut into quarters of as nearly the same size as possible. Place in cold water until required for cooking. To boil, place in boiling water with a little salt (for every half gallon of water, 1 tablespoonful of salt), boil until tender (young carrots will cook in 15 minutes), strain through a wire sieve, place on a vegetable-dish and serve hot.

497. Parsnips.—Wash thoroughly, and scrape well, removing any black specks with the knife, and if very large, cut the thick part into quarters. Place them in a vessel of boiling water, salted as for carrots, and boil rapidly until tender. Take them up, drain, and serve on a vegetable-dish.

498. Turnips.—Pare them and if large divide into quarters, otherwise cook whole. Place in saucepan of boiling water salted as described above and boil gently until tender, generally requiring half an hour. Turnips are frequently served mashed. After being well boiled, drain through a wire-sieve or colander and squeeze them as dry as possible by pressing them with the back of a plate. When dry place in a clean saucepan and add butter, salt, and pepper to taste. Keep stirring them over a fire till butter is well mixed, dish and serve hot.

499. Beetroot.—Remove leaves one inch from the crown. Rub off as much dirt as is possible with the hand. Place in boiling water and allow to boil from one to one and a-half hours according to size; then strain off the water and allow to cool. When cold, peel them, cut into thin slices, place in vinegar, adding pepper and salt to taste. The great object in cooking beetroot is not to prick or break the skin before they are cooked, otherwise they will loose the rich, red colour. A good method of cooking them is to place them in nets first, so that they can be more easily removed from the cooking vessel.

500. Scrambled eggs.—Two eggs, ½-oz. butter, 1 tablespoonful milk, pepper and salt, 1 slice of hot buttered toast.

Beat up the eggs, add to it the milk, pepper, and salt, melt the butter in a saucepan, pour in the egg-mixture, and stir until the egg is just set, spread it on the prepared toast, and serve hot.

501. Poached egg.—Break the egg into a cup to make sure it is fresh. Take a frying-pan and fill it three parts full of clean water (if only one egg is required, a small saucepan will be more suitable), add a little salt and a few drops of vinegar or lemon-juice, place it on the fire and as soon as it boils, turn the egg into it. Be careful not to let it boil too fast; keep the yolk of the egg covered with the albumen by the aid of an egg-slice; allow to boil for 3 to 3½ minutes; take it out, trim the edges, and serve hot on a small piece of buttered toast.

502. Savoury omelet.—Two eggs, ½ ounce of butter, 2 teaspoonfuls of chopped parsley, 2 drachms of milk, pepper and salt.

Break the eggs into a basin, beat them well with a fork, add milk and parsley, season with pepper and salt. Dissolve the butter in a frying or an omelet pan. When quite hot, pour in the mixture, stir slowly with a fork over a quick fire and shake the pan. When the eggs begin to set, shape and roll the omelet on one side of the pan, allow it to take colour, then turn quickly on to a hot dish and serve.

503. Sweet, or jam omelet.—Two eggs, 2 drachms of milk, ½ oz. of sugar, ½ oz. butter, ½ to 1 oz. of jam, a pinch of salt.

Break the eggs into a basin, beat them well, add the milk, half the sugar, and the salt. Melt the butter in an omelet pan, and when this is hot, pour in the other mixed ingredients, and stir over a quick fire. When the eggs begin to set, shape and roll the omelet towards the edge of the pan, allow it to take colour, put the jam previously warmed in the centre, fold in the edges, turn the omelet on to a dish, sprinkling over it the remainder of the sugar, and serve hot.

Puddings.

504. Rice-pudding.—One oz. Patna or Carolina rice, $\frac{3}{4}$ pint of milk, $\frac{1}{2}$ oz. sugar, 1 egg.

Wash the rice, put it in a saucepan with the milk, and let them simmer until the milk is thick, add the sugar and flavouring and well-beaten egg, pour the mixture into a slightly greased pie-dish or pudding-tin and bake in a moderate oven from 20 minutes to half an hour, dredge with sugar and serve.

Note.—Lemon, cinnamon, nutmeg, cloves, and other spices may be issued as flavouring. When flavouring is used, it should be put in the pudding just before it is baked. A thin piece of lemon-rind boiled in the milk and removed before baking is found excellent.

Other farinaceous foods which can be used and suitable for milk-puddings are tapioca, sago, barley, cornflour, semolina, etc.

505. Tapioca-pudding.—Three-quarters of a pint of milk, 1 oz. of tapioca, $\frac{1}{2}$ oz. of sugar, 1 egg, flavouring-essence.

Put the tapioca to soak in the milk for a few minutes, then cook over the fire until the tapioca is quite tender. When it is cooked let it cool slightly, then add sugar and beaten egg and a few drops of flavouring essence. Butter a pie-dish, pour the pudding into it, and bake for about twenty minutes.

506. Custard-pudding.—One pint of milk, 2 eggs, 1 oz. sugar, flavouring.

Beat the eggs, add to them the milk and sugar and flavouring, pour the custard into a pie-dish, and bake in a moderate oven for twenty minutes; sprinkle sugar over, and serve either hot or cold. The same ingredients can be put in a greased basin and steamed, or they can be put in a double saucepan or jar and boiled.

507. Savoury custard-pudding.—A savoury custard can be made by substituting herbs, chopped meat, and pepper and salt for sugar and flavouring.

508. Suet-pudding.—One oz. beef suet, 1 oz. flour, $\frac{1}{8}$ oz. baking-powder, and $\frac{1}{16}$ oz. of salt.

Remove the skin from the suet and chop it very finely. Put it in a basin with the flour, baking-powder and salt, and stir. Work into a smooth paste and fill into small, well-greased moulds. Cover each with greased paper and steam for forty-five to sixty minutes. Turn out and serve.

509. Sago-pudding.—One oz. sago, $\frac{3}{4}$ pint milk, 1 egg, $\frac{1}{2}$ oz. sugar. Proceed the same as for rice-pudding.

Jellies.

510. Calves'-foot jelly.—Two calves' feet, half-pound of loaf-sugar, the shells and whites of five eggs, the rind and juice of two lemons, $\frac{1}{2}$ oz. isinglass, 1 glass of sherry, and 6 pints of cold water (to make one quart of jelly). Scald the feet well to remove all hair, split them in two, remove fat, wash well in hot water, and put in a clean saucepan with the whole of the water. Place on fire and allow to

simmer for 6 hours. Then strain through a sieve into a large basin, and put in a cold place to set. After the liquor is strained off, measure it to ascertain that the requisite quantity remains, *i.e.*, 2 pints, 6 ounces (the six ounces is allowed for fat and sediment); if more than this quantity, return to saucepan and let it simmer down to the above amount. If there is a less quantity, make it up with boiling water. When cold, carefully remove any fat from the surface and wash well with warm water to remove any traces of fat. Turn jelly out of the basin and remove any sediment from below. Wipe the jelly with a clean cloth and break into small pieces. Whisk well the shells and whites of the eggs with the sugar, then stir the whole of the ingredients together. Place the saucepan on the fire with the jelly and all ingredients in it. Let it gently come to the boil, but do not stir after it begins to get warm. Allow to simmer for 5 minutes, then pour in half a cup of cold water, and withdraw the saucepan from the fire carefully so as not to shake the jelly. Cover and allow it to stand for half an hour near the fire. Meanwhile prepare the jelly-bag from some fine flannel, wash it well with hot water (without soap or soda), wring dry and fasten on top of a rimmed basin. Pour the jelly carefully through it near the fire to prevent it setting. Now dip the moulds into cold water for a few seconds and pour the jelly into them, and place in a cool spot to set; or ice may be packed around the moulds. When required for table, dip the moulds into hot water and wipe outside with a cloth. Lay a dish on top of the mould and turn it quickly over. It is sometimes also served in broken square pieces. Earthenware or glass moulds are preferable to those made of tin or pewter. Cow-heels can be used instead of calves' feet, but the preparation takes longer.

511. **Milk-jelly.**—Half-pint of milk, ¼ oz. gelatine, rind of ½ lemon, 1 oz. sugar.

Put the gelatine in the saucepan with as small a quantity as possible of water to melt it; add the milk, sugar, and lemon-peel cut very thin, and stir over very moderate heat until all is well blended; then strain it into a basin and stir occasionally until it is cool. Pour it into small moulds and put in a cool place to set.

512. **Lemon-jelly.**—Half-pint of lemon juice, 1½ pints of water, 6 oz. of sugar, 1 pinch of cinnamon, 4 cloves, 2½ oz. gelatine, the rind of 4 lemons thinly cut, 2 whites of eggs and the shells.

Put all these ingredients into a saucepan together. Whisk until it boils. Let it stand for five minutes. Strain through a clean cloth, previously scalded. When firm turn out into jelly-moulds.

513. **Wine-jelly**—If wine is allowed, add one gill of sherry to the above, in which case use that amount of water less.

514. **Egg-jelly.**—Two lemons, 6 oz. sugar, 2 eggs, ½ oz. gelatine.

Put the gelatine into a saucepan, add to it the sugar and lemon-rind, strain on to this the lemon-juice, and make up to one pint with water, to this add the eggs previously beaten, then stir over the fire until the gelatine is melted and the eggs are well blended; the

mixture must not boil. Strain into small moulds, and put them in a cool place to set, and turn out when required.

The chief points in preparing egg-jelly are, firstly, that the jelly must not be allowed to boil (if it does boil, the albumen of the eggs become hardened and indigestible), and secondly that the lemons must be very thinly peeled, or the jelly will be bitter.

Beverages, &c.

515. Lemonade.—Two large lemons, 1½ oz. sugar to every 2 pints of boiling water.

Put the thinly-peeled lemon-rind, the lemon-juice, and sugar into a jug, and pour over this the boiling water. Cover and let cool, then strain and serve. A little more sugar may be added if needed. Great care must be taken to peel the lemon very thinly and to remove the white skin afterwards, otherwise the lemonade will be bitter.

516. Toast-water.—Toast three slices of stale bread to a very dark brown, *but do not burn them* ; put them into a jug, pour over a quart of boiling water, cover closely, and allow to stand on ice or in a cool place until cold ; strain. A little wine and sugar may be added if allowed.

517. Oatmeal-tea.—Three oz. of coarse oatmeal, 1 quart boiling water, the thin rind and juice of half a lemon, 1 oz. sugar.

Put the oatmeal into a jug. Pour on to it the boiling water and add the thin rind of half a lemon and the sugar. Cover the jug and let it stand near the fire for an hour or more. Then strain off the tea and serve it.

518. Tea.—In making tea the vessel must be quite clean. It should be heated and rinsed with hot water, the dry tea put in and boiling water poured over it, and the pot then closed for four or five minutes to allow the tea to brew. It should then be strained, and the leaves well rinsed with the additional boiling water required before adding the sugar and milk. When making large quantities of tea, it will be found better to put the dry tea into thin muslin bags, loosely tied so as to allow sufficient space for the leaves to expand and give out their full flavour. Place them in the vessel, pour on the boiling water, and allow to remain in a warm place closely covered for four or five minutes ; then withdraw the bags and add the necessary milk and sugar and serve as hot as possible. Tea should never be made in a boiler that has contained broth or soup.

519. Coffee.—To prevent adulteration, coffee should be bought in the bean and ground. Care should be taken that only sufficient coffee is ground for the day's consumption, as when the bean is broken the aroma quickly escapes. Coffee of an inferior quality may be improved by the addition of chicory, but not more than 2 oz. of it to 1 lb. of coffee. Beans and chicory are used in the adulteration of coffee. Chicory may be detected by sprinkling a little of the mixture on some water in a glass. The chicory at

once sinks to the bottom, whilst coffee will float for a while. If a little is shaken with water, the coffee will rise and the chicory sink. Coffee should not be allowed to boil, as by doing so its aroma is dissipated. It should, if possible, be first warmed, which causes each grain of the powder to separate, then the amount of boiling water required should be poured on it. The cans should be well rinsed with hot water, the dry coffee placed in them and the boiling water added gradually, so as thoroughly to extract its strength. Coffee should be made immediately before being required for consumption and served up as hot as possible, and the required amount of hot milk and sugar added.

520. Cocoa.—This should always be made into a paste in the first place. Boiling water is then poured over, and sugar and milk added. Then boil the whole for two or three minutes in order to cook the starch which it contains. Stir well and serve. One teaspoonful of cocoa for each half-pint will be found sufficient; milk and sugar in the same proportion as for tea.

521. Rice-water.—Carolina rice 2 oz., sugar 2 oz. to every 5 pints.

Wash the rice thoroughly in cold water, then soften by steeping it for three hours in a quart of water kept at tepid heat; afterwards boil slowly for an hour and strain. This may be flavoured with lemon-rind or clove. The sugar may also be add if liked.

522. Barley-water.—Two oz. barley, 2 oz. sugar for every five pints.

(1) *Clear.*—Blanch the barley by covering it with cold water, bringing to the boil and straining; then put it back into the saucepan and add five pints of cold water. Bring it to the boil and let it simmer for half an hour. Strain and add the sugar. Allow to cool.

(2) *Thick.*—Proceed as above, only instead of boiling for half an hour, boil down to two-thirds of liquid. Strain, and add sugar.

As barley-water will only keep a few hours, it should stand in a cool place and should never be heated to boiling point again.

523. Barley-milk.—Quarter of a pound patent barley, 1 pint of milk, ½ pint of water, 1 oz. of sugar.

Boil the barley in the milk and water for two hours, sweeten with the sugar and serve while it is just warm.

524. Egg-flip.—Two eggs, ½ oz. sugar, 1 small glass of wine or lemon if allowed.

Put the yolks of the eggs and the sugar in a tumbler, and stir until creamy. Beat the whites of the eggs to a stiff froth and stir it lightly in. Serve. Half the juice of a lemon or a little wine (sherry or Marsala) can be used to flavour if allowed.

525. Junket.—Half a pint of milk, 1 teaspoonful sugar, teaspoonful rennet, 2 drops of flavouring essence.

Dissolve the sugar in the milk. Warm the milk to 98° F. Add the rennet and flavouring. Allow it to cool, and when firm place it on the ice for about an hour. Serve with sugar, and cream if allowed.

526. Gruel.—Two oz. of oatmeal, $1\frac{1}{4}$ oz. sugar to make 2 pints. Mix the oatmeal with a little cold milk or water; boil the remainder and pour it, when boiling, on the oatmeal; return the mixture to the saucepan and boil for ten minutes. Add the sugar and serve very hot.

527. Flour-gruel.—Mix a teaspoonful of flour with enough milk to make a smooth paste, and stir into it 1 quart of boiling milk. Boil for half an hour and be careful not to let it burn. Salt and strain.

528. Arrowroot-gruel.—Mix one teaspoonful of arrowroot with four of cold milk; stir it slowly into half a pint of boiling milk and then let it simmer for five minutes. The mixture must be stirred all the time. Add a half-teaspoonful of sugar, a pinch of salt, one of cinnamon (or in place of cinnamon use a little brandy or a dozen large raisins).

A corn-starch, or rice-flour gruel can be made in the same way.

529. Oatmeal-porridge.—Two oz. of oatmeal with 8 oz. milk.

Stir the oatmeal gradually into a pint of boiling water, and let it come to the boil whilst stirring. Cook gently for about an hour. Add a pinch of salt and serve with cold milk. The porridge must be stirred occasionally whilst cooking.

530. Milk-porridge.—One oz. of flour, 1 pint of milk, $\frac{1}{4}$ teaspoonful of salt.

Heat the milk in a clean saucepan, saving enough cold milk to mix the flour to a smooth batter. Add this gradually to the hot milk and cook for half an hour, stirring frequently. Add a pinch of salt and serve.

531. Bread-and-milk.—Rub bread-crumbs through a fine sieve, put them in a cup and cover with boiling water, then place a saucer on the top of the cup; allow the crumbs to steep for fifteen minutes, drain off the water and in its place pour on some warm milk. Beat the whole well up, and then put the bread and milk into an enamelled saucepan and boil gently for a minute or two, stand it aside to cool a little, and, before giving it to the patient, stir it, and see that it is nice and smooth, adding a little sugar and more milk if liked.

532. The Aymard Milk-sterilizer.—Directions for sterilizing milk with the Six-gallon Tin Sterilizer:—

The water is placed in the outer pan to such a height that it will run out of the tap. The tap is turned off, and the fire is lighted. The two lids are now removed, and the required quantity of milk is poured into the milk-chamber (it is best to strain the milk previously). Now replace the two lids and insert the thermometer through them. In about twenty minutes the milk will indicate upon the thermometer a temperature of 195° F. The furnace-door must now be opened and the milk kept at this temperature for five minutes; then rake the fire out. The milk is now sterilized. In order to cool the milk, remove the thermometer and the outer lid, but

on no account the inner lid, for if the inner lid is removed even momentarily a scum forms. Introduce a hose-pipe into the outer pan, or in case no constant supply it available, pour water in with a bucket, at the same time turning on the tap. Place a thermometer again in the inner lid in position. The cooling process must be continued until the temperature falls tc 100° F. After this the thermometer may be removed, cleaned, and placed in a position of safety. The milk is now ready to be served out, and should be ladled into vessels for distribution ; or if intended to be kept in the canteen should be transferred to a separate vessel. It should not be stored in the sterilizer. The vessel the milk is transferred to should be covered with a clean cloth to prevent unnecessary exposure to the air. The milk should be stirred every three or four minutes during heating and cooling by drawing the handle of the stirrer up and down once or twice. In order to get all the milk out of the sterilizer, lift it bodily out of the pan and pour it out through the spout. The sterilizer should be cleaned by filling the milk-chamber with cold water, allow it to stand for a short time, then wipe out and dry. The water in the outer pan will be ready for use without re-filling. Always leave the lid off the sterilizer until required for use again. No sand should be used in the milk-chamber, and soda is unnecessary. If the thermometer gets broken the following means may be adopted, viz. :—In about twenty minutes from the commencement of heating, steam will issue freely from the lid and spout. This does not occur until the temperature of the milk has reached 195° F., as previous to this the milk-chamber acts as a condenser.

533. Preserved provisions.—As a rule in most cases it is only necessary to remove the lid of the tin and place the latter in a stew-pan of boiling water. The pan should be kept on the fire or in the oven until the contents are thoroughly warmed, then remove the fat from the top and serve hot. In making a stew of beef or mutton, the vegetables should be cooked first, after which the meat cut up into squares should be added. Season according to taste. Preserved meat may also be used to make curries, pies, &c., and so form an agreeable change on service or in camp.

534. Peptonized foods.—For patients whose digestive organs are extremely week, this kind of food is of the utmost value, because part of the digestion is thereby accomplished, and the digestive functions of the stomach are relieved. Peptonized food must be administered with every precaution and care, and only under medical directions.

To peptonize any liquid food or stimulant, a certain quantity of liquor pancreaticus and bicarbonate of soda is employed in the form of an infusion. The quantity used varies according to the degree of peptonization. To one pint of liquid the average quantity used is one tablespoonful of liquor pancreaticus, and a salt-spoonful (25 grains) of the bicarbonate. As soon as the liquid has reached the degree needed it must be served immediately ; or

it must be boiled up at once so as to prevent any further action of the liquor pancreaticus; otherwise, if left standing too long, a bitter and objectionable flavour will be imparted. If peptonized milk is consumed as soon as the process is carried far enough, that is, to the degree needed by the patient, the actual boiling need not take place.

Note.—Liquor pancreaticus is a chemical preparation, produced from beef pancreas (pancreatine), which acts similarly to pepsine, possessing the power of digesting albumen and turning it into a soluble form.

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